Materials Engineering in Product Design & Manufacture

Materials & Methods

135 Case Histories Tell You:

How To Reduce Costs Through Materials Selection

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May, 1954

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MAY 1954 VOL. 39, NO. 5

MATERIALS SHOW ISSUE

HOW TO REDUCE COSTS THROUGH MATERIALS SELECTION 69

Here, in the longest single article ever to appear in Materials & Methods, is a selection of 135 examples showing how materials can be used as a means of reducing costs. Illustrations have been gathered from a cross-section of industry to prove that savings can be achieved on almost any type of product. Study these case histories to learn how the same principles can be applied in your work.

BASIC MATERIALS EXPOSITION PROGRAM AND DIRECTORY 117

This special feature is the only complete program and directory of both the Materials Show and the Basic Materials Conference. It lists all exhibitors and their booth locations. Also featured in the directory are detailed descriptions of the exhibits. All details of the Conference sessions are included to provide a concise guide for your use at both the Show and Conference.

PLUS THESE TWELVE REGULAR FEATURES AND DEPARTMENTS

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The Materials Outlook

LEADED ALLOY STEELS

Leading of steels to increase machinability has now been extended from the carbon steels to an alloy grade. Annealed AISI 4140 chromium-molybdenum steel, with 0.15 to 0.35% lead, can be machined at the same speeds and feeds recommended for C-1117. The lead addition is claimed to be without deleterious effect on mechanical properties. (More details in next month's issue.)

SILICONE-PHENOLIC COATINGS

Copolymers of silicone and oil-modified phenolic resins have been developed to supplement conventional phenolic resins in protective coatings where added resistance to heat, weathering, moisture and chemicals is desired. Although the resins contain up to 50% silicone, varnishes based on them are claimed to be identical in appearance and application to standard phenolic varnishes. Water and chemical resistance of the new films is claimed to surpass that of comparable silicone alkyds. The resins are available only in laboratory quantities at present.

SEAMLESS TUBE OF 19-9DL

19-9DL, a predominantly austenitic stainless steel widely used in jet engines, experimental aircraft and gas turbines, is now commercially available in seamless tube for the first time. The tubing is being produced by the hot steel extrusion process.

FINISH FOR LURIUM

A German-developed electrochemical process claimed to give a brilliant surface finish on parts made of Lurium is being licensed to various finishing plants in this country. Lurium, the trade name for high-purity (99.99%) aluminum, was introduced in the United States last year.

ANOTHER POWDER COMPACTING METHOD

The plastic properties of lead can be utilized to advantage in powder metallurgy, according to a paper presented in Germany. The paper described the production of a tungsten cylinder. Tungsten powder is packed between a lead core and an external lead tube. The ends of the tube are sealed and the whole assembly subjected to high hydraulic pressure. The tungsten cylinder is freed by melting out the lead and it is then ready for sintering.

(Continued on page 4)

The Materials Outlook *(continued)*

GLASS-PLASTIC DEVELOPMENTS

Pre-impregnated material for reinforced plastic molding which utilizes a new concept of glass fiber orientation is now being evaluated by parts of the aircraft industry. The glass is neither cloth nor mat but is made by superimposing a number of warps in a staggered pattern. This construction is claimed to lower cost, increase strength in many cases, and allow the glass to assume more readily the contour of surfaces having double curvature . . . Rotor blades of phenolic-glass reinforced plastic have passed what may be regarded as a major test, though only the first of many to come. Slightly over 4 in. in length, the turbojet compressor blades ran at rated speed in the third rotor stage for 100 hr at about 300 F. Die-cast aluminum dovetail roots were used . . . Glass cloth woven from roving instead of yarn and sized with any one of a variety of high-quality glass finishes is now commercially available. Fibers having finishes compatible with laminating resins cannot be twisted into yarn; however, they can be used as roving. This saves the molder or pre-impregnator the expense of burning off incompatible sizings and applying new ones. The new cloth is claimed to be stronger, more wettable and cheaper than conventional cloth.

NEW FLUX FOR SOLDERING ALUMINUM

A new soldering flux for aluminum has been developed. It reacts with aluminum oxide and with the underlying aluminum, depositing metallic tin on the aluminum surface and forming aluminum chloride which volatilizes and leaves no corrosive residue. The tin temporarily prevents new oxide formation and alloys readily with both aluminum and zinc-base solders.

BORON POLYMERS

A promising series of boron-containing polymers is reported under development. Interest is attributable primarily to the plentiful and cheap raw material (borax) and to outstanding heat resistance obtained in laboratory tests. The high heat resistance was obtained by incorporating phosphorus. By using diborane and ammonia with the boron it is possible to get a material structurally similar to polyethylene.

LATEST IN STEELMAKING

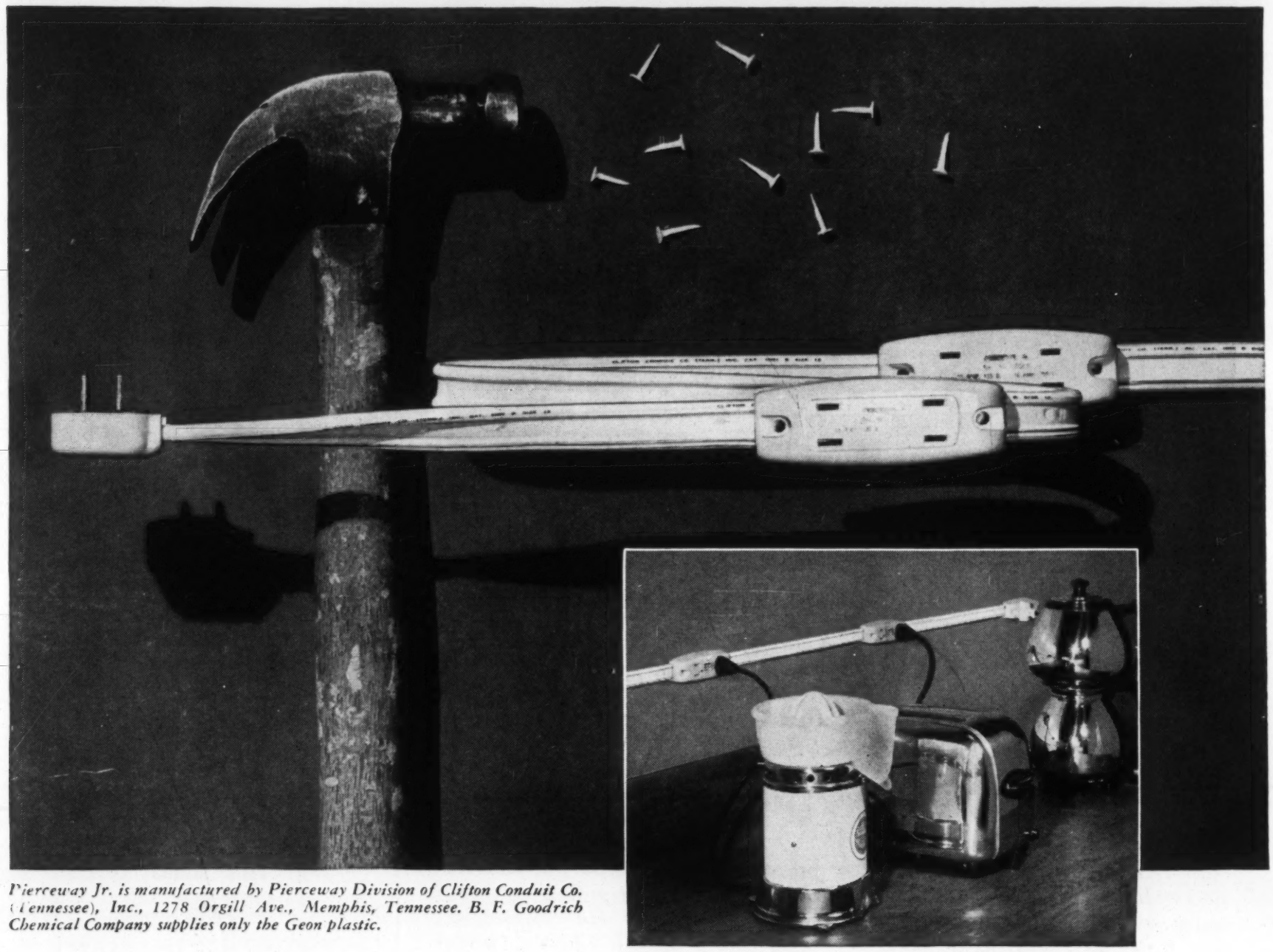
Two recent developments in steelmaking: One company is blowing argon gas through molten steel in order to remove soluble gases. Improved mechanical properties are reported. . . . Another organization is investigating the control of ingot grain size by imposition of low frequency vibrations during solidification.

MAGNESIUM SHEET FROM POWDER

High-strength magnesium sheet can be made by rolling powder extrusions of alloys containing zinc, zirconium and aluminum. Newly developed hot rolling techniques have produced ZK60 sheet with corrosion resistance equal to that of billet material.

Another new development using

B. F. Goodrich Chemical *raw materials*



Pierceway Jr. is manufactured by Pierceway Division of Clifton Conduit Co. (Tennessee), Inc., 1278 Orgill Ave., Memphis, Tennessee. B. F. Goodrich Chemical Company supplies only the Geon plastic.

More electrical outlets?... *All you need is a hammer!*

Handy String of 6 Duplex Outlets Made from Geon Materials

YOU hear this complaint often—there aren't enough outlets to take care of electrical appliances, power tools or lighting. Pierceway Jr., a 6-foot string of duplex outlets with copper conductors enclosed in a Geon polyvinyl plastic duct strip, does the job.

Pierceway Jr. comes in one package ready to install. All you need is a hammer and you're in business. For when you tack the Geon duct strip to wall, baseboard, workbench or beam, you have new outlets that are shockproof, fire-resistant and durable.

The manufacturer of Pierceway Jr. knew the versatile qualities of Geon polyvinyl plastic were right for the job. Geon has excellent electrical and physical properties—high dielectric strength, resistance to abrasion, does not become hard or brittle, resists oil, grease and many chemicals.

The many advantages of Geon materials may point up an idea for you to improve or develop a product—expand markets or open new ones. We'll help you select the Geon material best suited to your requirements. For technical information, please write Dept. GN-5, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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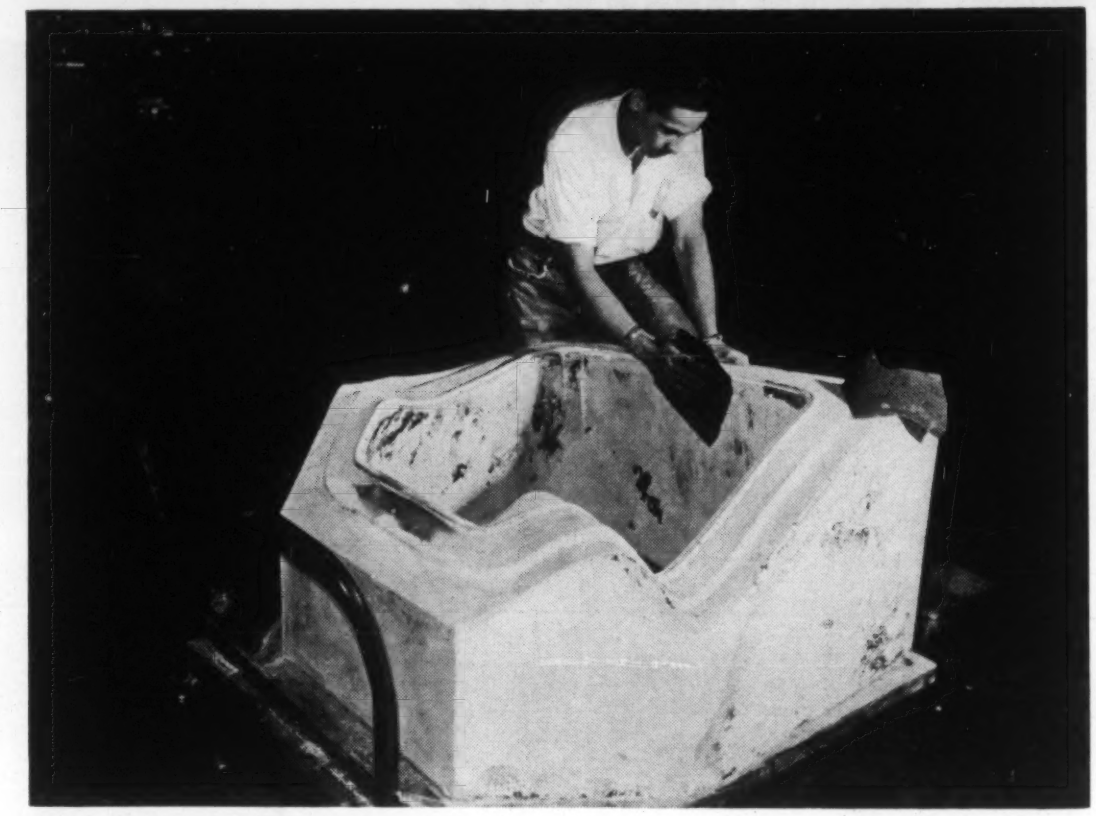


Plastic drawing die for metal forming gets finishing touches by hand sandpapering. *Chrysler Corp.*

Plastic Dies Cut Tooling Costs

In Detroit, they're making metal auto bodies with plastic dies, plastic bodies with metal dies, metal bodies with metal dies, and plastic bodies with wooden dies. It all boils down to how many bodies you want by when. At least that's what the engineers hope it will boil down to soon.

General Motors is gambling its prestige sports car, the Corvette, on the theory that plastic bodies will pay off at production volume of about 15,000 per year or less. Even using matched metal dies, a higher production rate than this looks impractical, yet equivalent tooling cost for metal bodies would set the company back upwards of $4\frac{1}{2}$ million.

Chrysler Corp. is pushing its developments in plastic dies for metal bodies rather than embarking on the more risky road of plastic automobiles. The corporation recently announced that it was making limited runs of truck body parts on presses equipped with large plastic drawing dies, compounded of a mixture of epoxy and other resins. The Chrysler plastic dies reportedly will withstand pressures up to 20,000 psi, and are quite easy to repair with a patching compound if they are chipped or permanently dented. Chrysler won't say how long the dies will last, (perhaps because they don't yet know for sure) but they do state that the cost of experimental plastic dies is 30% less than equivalent metal dies, and predict that cost savings of 70% will be attained in the near future.

Ford Motor Co. leans toward phenolic resin base dies for metal forming. One Ford reinforced phenolic die has run over 50,000 cycles with only three breakdowns, which were quite simply remedied by patching the plastic die.

General Motors' Fisher body plant is reportedly considering epoxy- phenolic dies for both truck bodies and short run models of high priced passenger cars.

At present it doesn't look as if plastic dies or plastic bodies will ever seriously enter the mass production automobile field in terms of annual production in the millions. The fast cycle and low material cost of metal bodies from metal dies is still a long way out front in any cost race. That is not to say, however, that the big automobile companies will not take advantage of the new materials in instances where they stand to save money. Fisher body does not turn out very many Cadillac limousines compared to the number of Chevrolet 2-doors that roll off the lines, and plastic dies may be just the ticket for some of the large size, short run limousine parts. The same applies to special-order busses and trucks turned out in low quantity—buyers soon may be able to get virtual custom treatment if their orders are sizeable.

Plastic body production will probably stay limited to the sport and custom car field and the production of experimental models put out to test public reaction to design innovations. The slow cycle and large amount of space required for plastic production will limit it to a small portion of Detroit's total for many years to come, barring some totally unforseen and revolutionary technical innovation in material or processing.

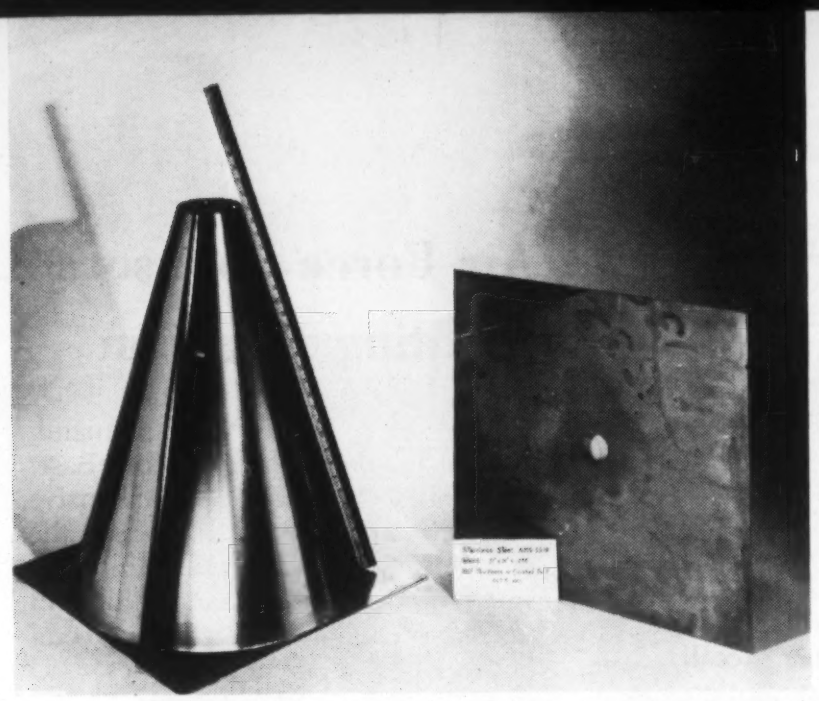
Gray Iron Castings Contest Open

The Gray Iron Founders Society has launched its 1954 Gray Iron Castings Redesign Contest. This annual contest, now in its fifth year, offers cash awards of $500, $250, and $100 for the first three winners.

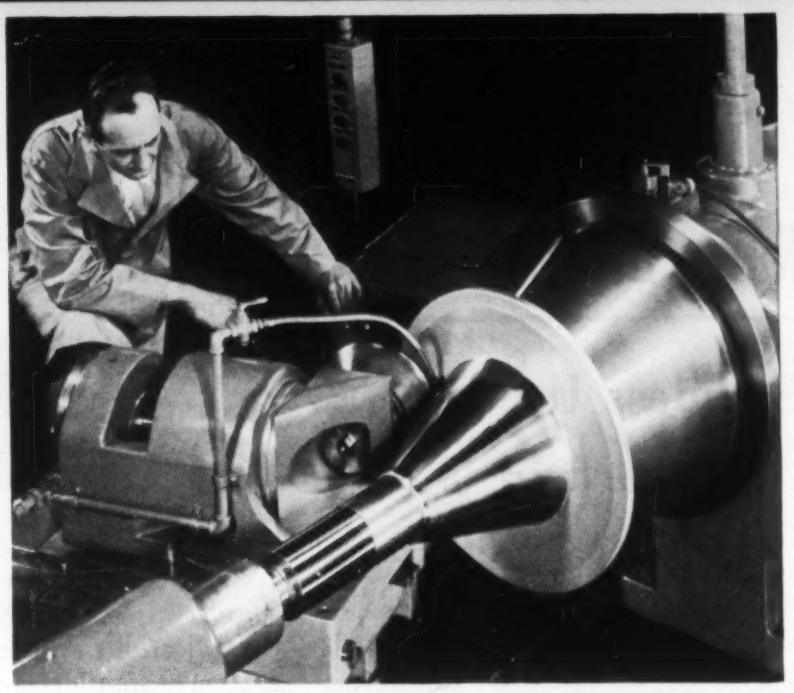
The purpose of the contest is to encourage more extensive use of gray iron in products formerly manufactured by competitive processes. Prize winning entries are used by the society as authentic case histories in its advertising series, which stresses the performance of gray iron as an engineering material.

No advance registration is required to enter the contest. Entries must be submitted by June 1, 1954 to the headquarters office, National City East Sixth Building, Cleveland, Ohio. Awards will be made in November.

The contest is open to all persons engaged in the metal working trades, and entries may be sponsored jointly by two or more individuals.



Jet engine exhaust cone formed from AMS-5510 stainless steel is shown with blank. Note unwarped condition of unused portion of blank at base of cone.



Roll forming lathe in process of shaping a stainless steel cone over large mandrel. Flange can be left at base of cone, or full cone run off circular blanks.

Roll Forming Process Shapes Tough Metals

A new metal forming process, christened "Floturning" by the Ohio lathe manufacturing firm of Lodge and Shipley, promises to fill several gaps between spinning, machining, and deep drawing in the production of metal parts.

At first glance, the process appears to be a logical extention of the standard process of spinning, but on closer examination it operates on a distinctly different principle. In spinning, the workpiece is, in effect, wrapped around the form, while this process cold flows the workpiece against the rotating mandrel, forming the part in a single pass. Since any given area of the metal is worked only once, extreme dislocation of metal is possible in one operation without further annealing. Very great pressure is applied to the metal blank by a hardened metal roller rather than the standard type of spinning tool. The machine is programmed for rate of advance, pressure, etc, and after initial set-up the only labor required is to remove the finished pieces and insert new blanks.

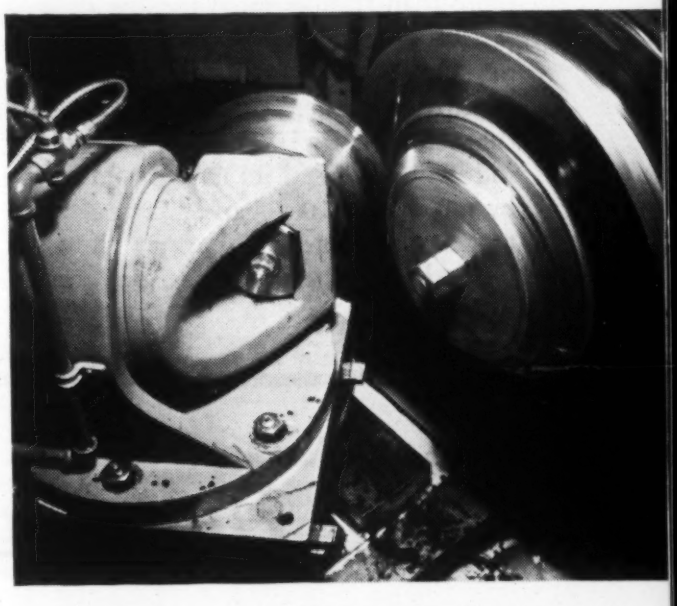
One of the most notable differences between Floturning and other processes is that the metal in the blank is displaced only at the point of contact of the tool and mandrel. The metal is displaced in a direction parallel to the axis of rotation, and as a result, the diameter of the finished piece is the same as the diameter of the original blank.

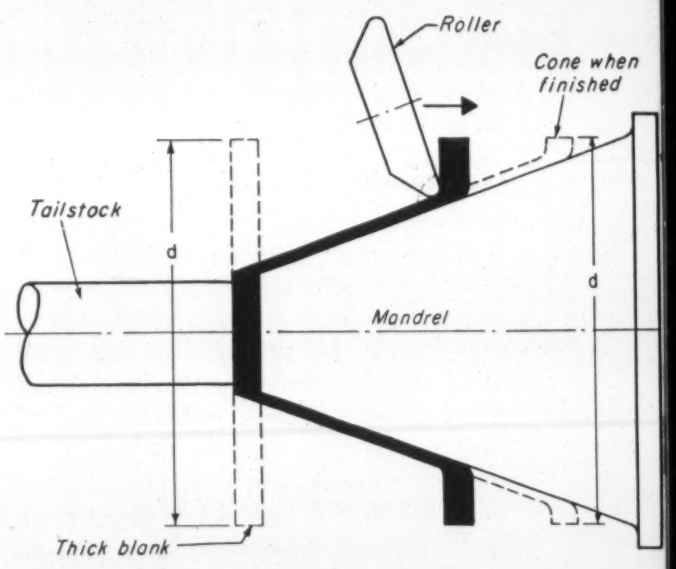
Conical, cylindrical, combinations of conical and cylindrical, and other complex shapes are formed by the new process. The blanks may be simple flat disks, machined blanks, forgings, drawn cups, wrapped and welded cylinders, or centrifugal castings. In most cases, a single pass in the machine produces a part of finished dimensions, which can be held to ± 0.002 in.

The new method is capable of forming many metals and alloys considered hard to machine. The process has been successfully used on all 300 and 400 series of stainless steels, Haynes Multimet, Universal Cyclops Uniloy 19-9, Inconel and Inconel X, Monel and K-Monel, and titanium T1-140-A, as well as copper, aluminum and mild steel. Maximum workable thickness of blanks of the harder materials is 5/16 in., while blanks of softer metals may run up to $\frac{1}{2}$ in. thick. The finished wall thickness is a function of the thickness of the blank and the angle of displacement. From a flat disk, a cone with an included angle of 30 deg may be formed in a single pass.

One advantage of this forming process is that it increases the strength and hardness of the metal worked. In contrast to the localized stresses developed in deep drawing, the parts produced by Floturning have hardness and grain structure similar to cold-rolled pieces. In a typical example, working Type 302 stainless

(Continued on page 296)





Above: Forming roller, left, is shown shaping 5/16-in. steel plate. For this operation, face plate and blank are bolted to mandrel rather than using tailstock. **Below:** Diagram shows how process reduces wall thickness of blank.

News Digest

Stainless Use At Record in '53

Industry used more stainless steel in 1953 than ever before, the American Iron and Steel Institute reported. The all time high of 1,015,303 tons—an increase of 85,000 tons over 1952—was reached despite a net decline in the use of stainless steel by the military and aviation industry. Wider use of stainless in many civilian applications in 1953 more than compensated for the drop.

Automotive and architectural use of stainless played a major role in making last year a banner year for the material. In 1953 the automotive industry increased its use of stainless by more than 100% over 1952. This may be attributed in part to the increased production of cars, but more important is the greater use of stainless in accessories and trim. Brushed stainless trim and wire wheels have proved good sales features, it is claimed, and are regarded as a trend on the part of automobile designers toward stainless—both as an economy measure and a design trend.

Store fronts and building entrances of stainless steel were largely responsible for a solid 47% increase in the use of stainless in architectural applications. Suppliers recall that 1951 stainless consumption was higher than 1952 due to several very large projects that were built; yet in 1953, with virtually no large single construction projects underway, and the use of stainless confined to smaller store fronts and the like, final total consumption was significantly ahead of all previous years.

Aviation use of stainless dropped 11% in 1953 and government demand dropped by an even larger 31%. 1953, however, still was the first year to see the production of stainless exceed 1,000,000 tons.

What They Said . . . . . .

Still Safe "The economy is moving downward from boom-boom to slightly below prosperity."—*Jules S. Blackman, Professor of Economics, New York University.*

Combined Operations "In the long run, the successful production of a part is a result of the combined efforts of every department within an industrial organization, and channels should be set up for soliciting ideas and coordinating them to make parts better and cheaper. Cost reduction is the ever important incentive toward improving manufacturing methods and at no time should we feel that our processes are beyond further development."—*R. J. Moran, Wright Aeronautical Div., Curtis Wright Corp. and Michael Field, Metcut Research Associates, in a paper delivered to the SAE.*

Quality "In the past few years circumstances have made it necessary for us, on occasion, to compromise in favor of production and against research and development. The times which lie immediately ahead place us in the position, in such cases, of compromising in favor of improved performance and quality, and it is our intention to do so. In the air, the margin between victory and defeat can be a few miles per hour in speed, a slight difference in maneuverability, a better or more reliable electronic tube or gun. In warfare there is no room for the second best in equipment, no matter how slight the margin might be."—*Roger Lewis, Asst. Secretary of the Air Force (Materiel) April 12, 1954.*

Atomic Power "Looking at the United States economy, atomic power does not promise to cut manufacturing production costs very much. If atomic power becomes *just competitive* with existing fuel and energy sources, there will be no over-all savings. If we accept the very optimistic assumption, namely that atomic power were to cut in half the costs of fuel and energy purchase to industry, even then the direct cost savings to manufacturers might run to only 3%."—*Professor Walter Isard, Massachusetts Insititute of Technology.*

Air Force Sponsors Welding Program

The Air Materiel Command, Wright-Patterson Air Force Base, Ohio, has authorized an extensive program intended to broaden the economical application of resistance spot, roll spot and seam welding in the fabrication for non-ferrous components of aircraft and missiles.

The primary objective is to increase the production applications of spot and seam welding in the fabrication of both structural and non-structural magnesium and aluminum alloy assemblies in gages up to a quarter of an inch.

Because of the magnitude of the problems involved in carrying the program to a successful conclusion, both the Air Materiel Command and Goodyear Aircraft, prime contractor for the project, sought and received the cooperation of many manufacturers, who supplied information concerning present practices and suggested possible avenues of attack.

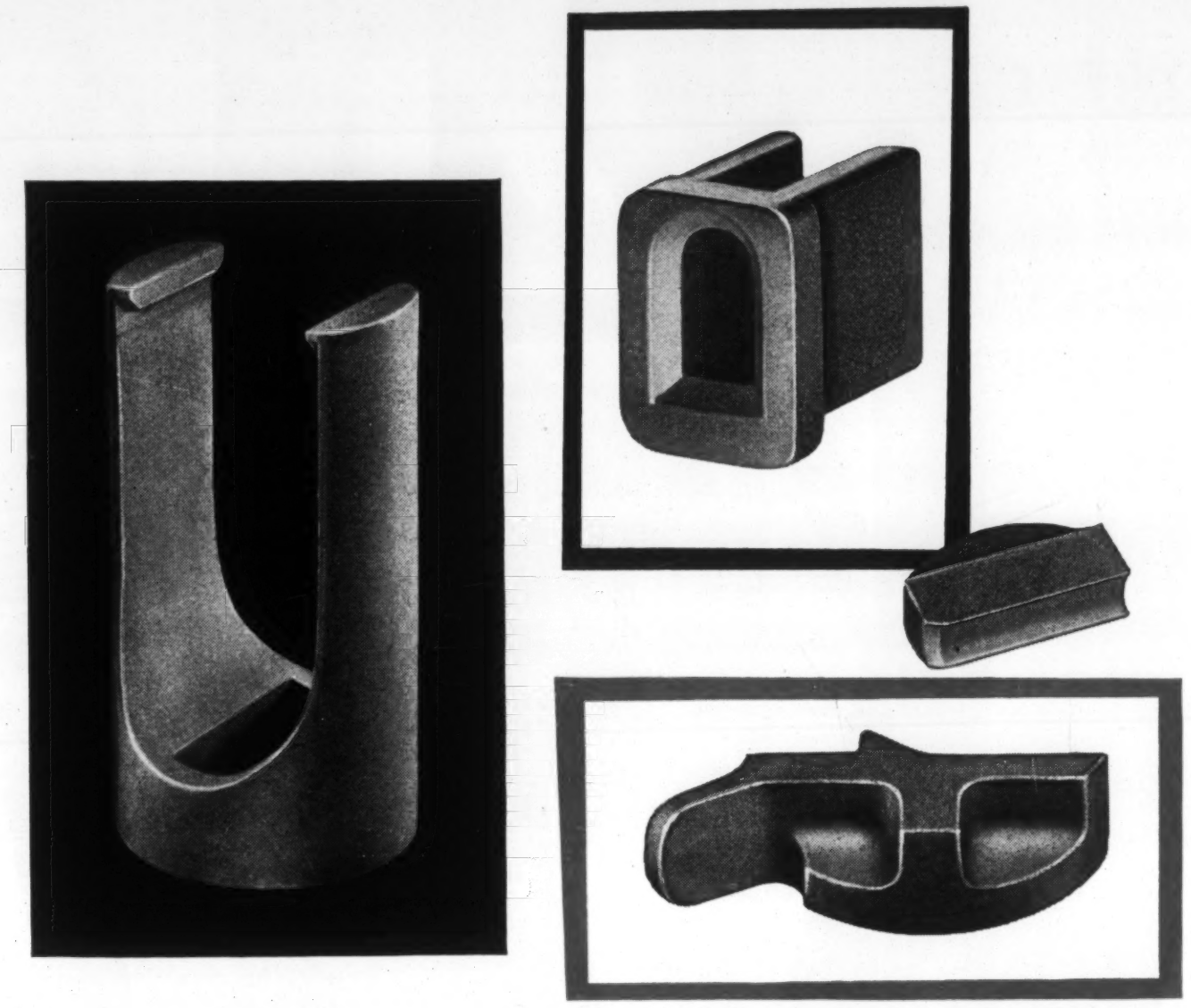
J. F. Snider, assistant manager of technical service at Goodyear Aircraft, is in charge of program coordination at GAC. Technical details are being handled by M. W. Seese, chief welding engineer of the company. Battelle Memorial Institute of Columbus, Ohio is assisting the project under subcontract to Goodyear Aircraft.

GAC and Battelle engineers will screen, summarize and evaluate all available data, published or unpublished, dealing with the resistance welding of magnesium, aluminum, titanium and their alloys. Subsequent phases call for the refinement and further development of welding techniques and re-evaluation of the mechanical properties of welds attainable with modern welding machines under production conditions.

A review of applicable specifications and other written material dealing with the simplification, re-determination and modernization of specifications for spot and seam welding performed on modern equipment will follow the initial work.

Final phases call for the development and standardization of basic design criteria for spot and seam welding, in addition to actual design and fabrication of structural components for test purposes.

(More News on page 11)



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In many cases design is restricted and function limited when alloy steel parts are made on conventional machinery from bar stock or forgings. Frequently such designs can be improved and production costs lowered by the use of precision investment castings. That's because this casting process permits the use of high alloy steels that are difficult to machine or forge.

Take these four component parts of a pneumatic tool for example. They are Accumet Investment Castings made by Crucible of 8620 steel. They have a smooth, satiny finish and are held to very close tolerances. If these parts were not made by this "lost wax" process, the pneumatic tool could not be produced at a practical cost in its present design.

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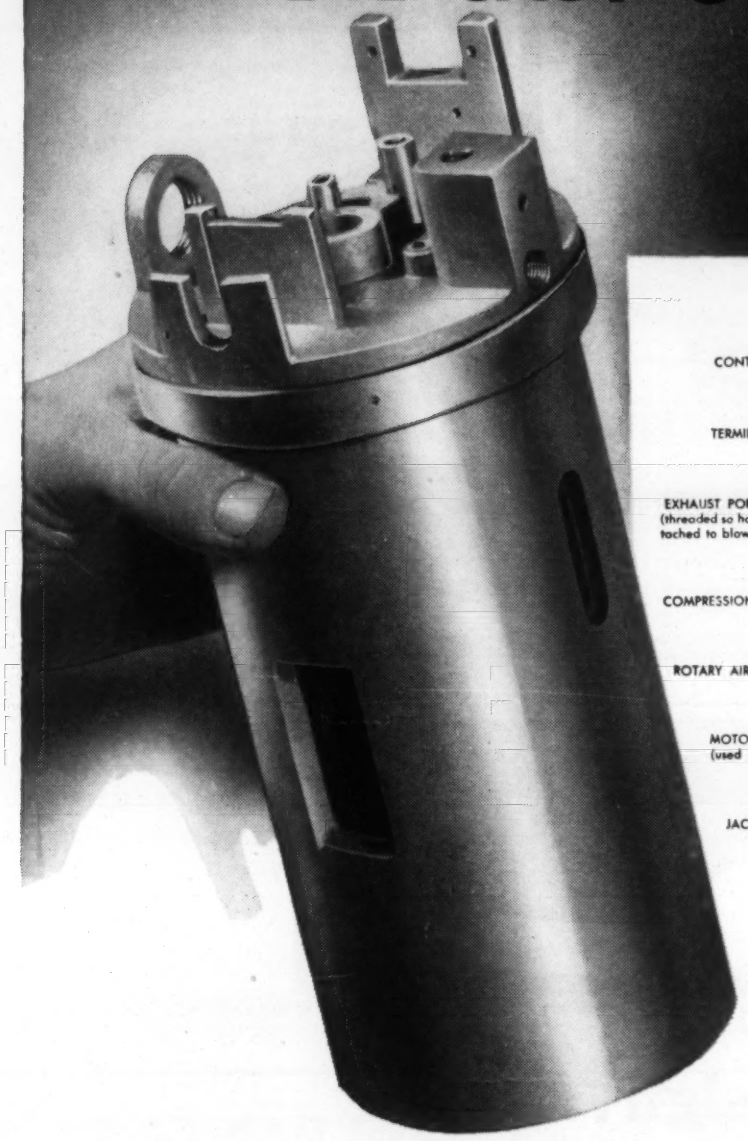
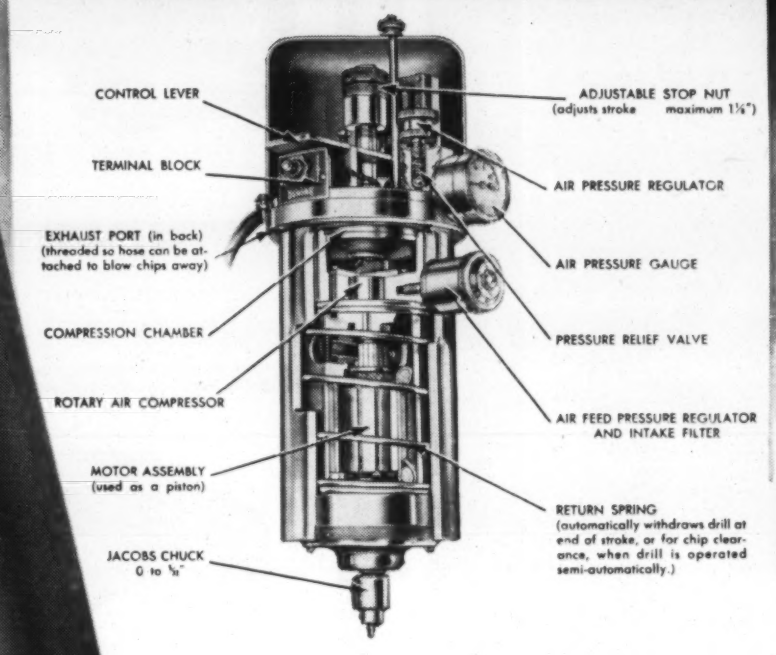




for DUMORE

Here's Why.....

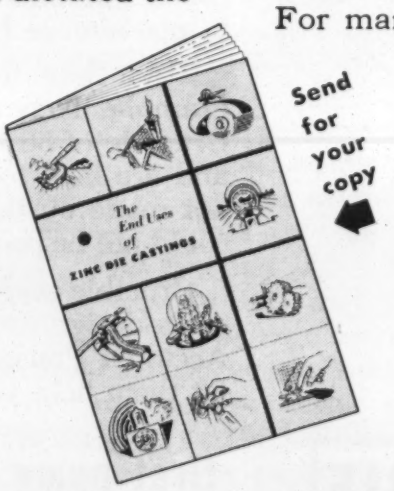
Since the above part is the largest single component of the pictured Dumore automatic drill head, the selection of material and process for its production was of paramount importance in achieving high efficiency and low cost of the finished product. The following factors dictated the choice of ZINC Die Casting:

Rapid Production—Because of the extreme complexity of shape and close tolerances attainable with ZINC Die Castings, an absolute minimum of secondary operations—burr removal, drilling, tapping, burnishing—are required to place this housing in service.

Low Cost Assembly—In addition to housing the entire motor assembly, compressor and return spring (see cutaway view), this hollow one-piece ZINC Die Casting has cored openings and cast projections to simplify assembly of all other operating components.

High Strength—A drill head comes in for a lot of abuse in its everyday usage and the inherent *toughness* of the ZINC Die Cast housing assures trouble-free performance of this machine tool under such conditions.

For many other instances of successful product engineering with ZINC Die Castings ask us—or any die casting company—for a copy of "The End Uses of Zinc Die Castings."



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Materials BRIEFS

De-icer A British concern manufactures electrically heated windshields for aircraft by coating glass with a layer of gold about 1/4 millionth of an inch thick. The thin gold layer passes light, conducts low voltage current sufficient to warm the glass.

Log Savers Splits in the ends of logs which prevent their use as "peelers" for plywood veneer can be mended by using plastic plugs about the size of an ax blade. A West Coast firm is now marketing the plugs under the name "Scotch Clips."

Hot Bugs Sewage disposal plants may play an important role in disposing of radioactive wastes from industry. Researchers are working on a method of biological concentration of radioactive materials into sludge which can be burned to reduce the volume of the radioactive residue and thus simplify disposal.

Substitute High-strength, low-alloy steels with tensile strengths of 220,000 lb are likely substitutes for titanium in case war emergency demands greatly increased production of aircraft designed around the new metal.

Die Pads Glass fiber mats are used to insulate Kirksite and lead dies when hot-working titanium.

Spell of the Yukon The hydroelectric potential of the Yukon River is being eyed for aluminum production by both U. S. and Canadian firms. Last year U. S. interests were refused permission to divert the water to Alaska.

For Better Hearing The Bell System has made its transistors available royalty-free to hearing aid manufacturers.

Brazing Movie A 22-minute sound film demonstrating and explaining light metal brazing techniques has been produced by Alcoa. Prints are available for loan by request.

Framed Sales of aluminum windows jumped 34% in 1953.

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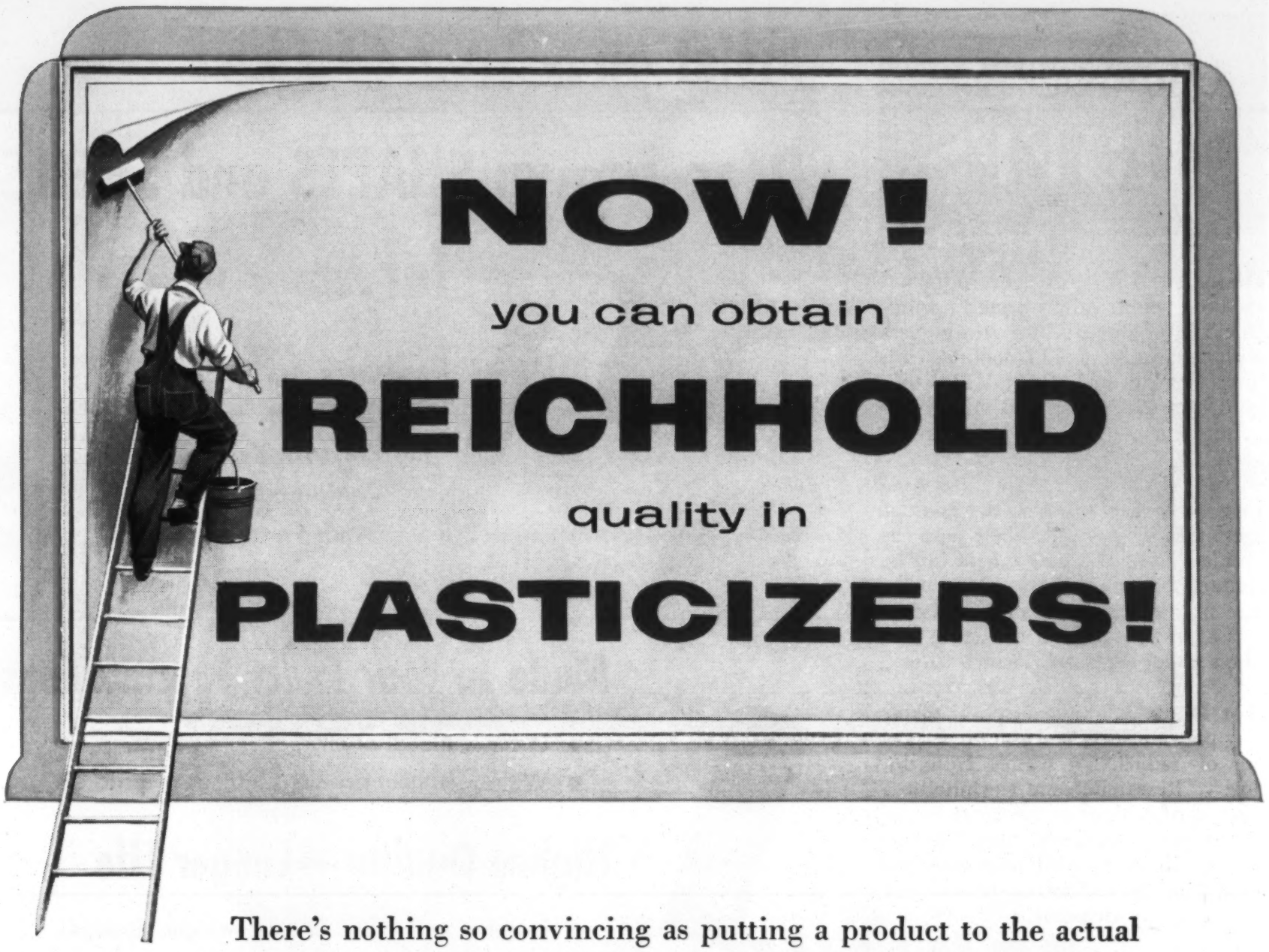

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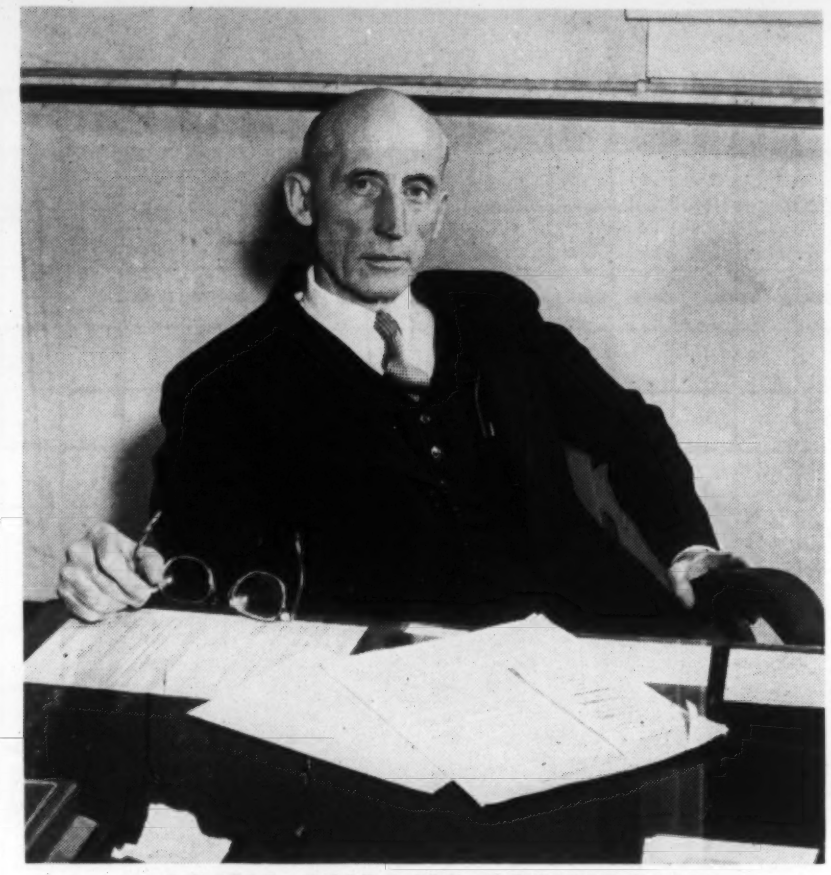


JOHN BURLIN JOHNSON
Chief Scientist, Wright Air Development Center, Wright Patterson Air Force Base, Ohio

Men of Materials . . .

their views on development and utilization of engineering materials in industry

In 1916, J. B. Johnson left the materials testing laboratories of the New York Central Railroad and took a position with the U. S. Army Signal Corps Flying Service, which at that time possessed about three flimsy flying machines. He was assigned to the Bureau of Aircraft Production—its purpose, to purchase aircraft. At that time specifications were rather simple, according to Chief Scientist Johnson: "If someone could make an aircraft that would get off the ground for a few minutes and fly at a certain speed, we would buy it . . . there was not too much concern about materials and material selection." An early crash due to a structural failure resulted in one of the first specifications for aircraft materials: the diagonal slope of the grain in spruce and ash used for longerons and spars was required to be "greater than 15 to 1".

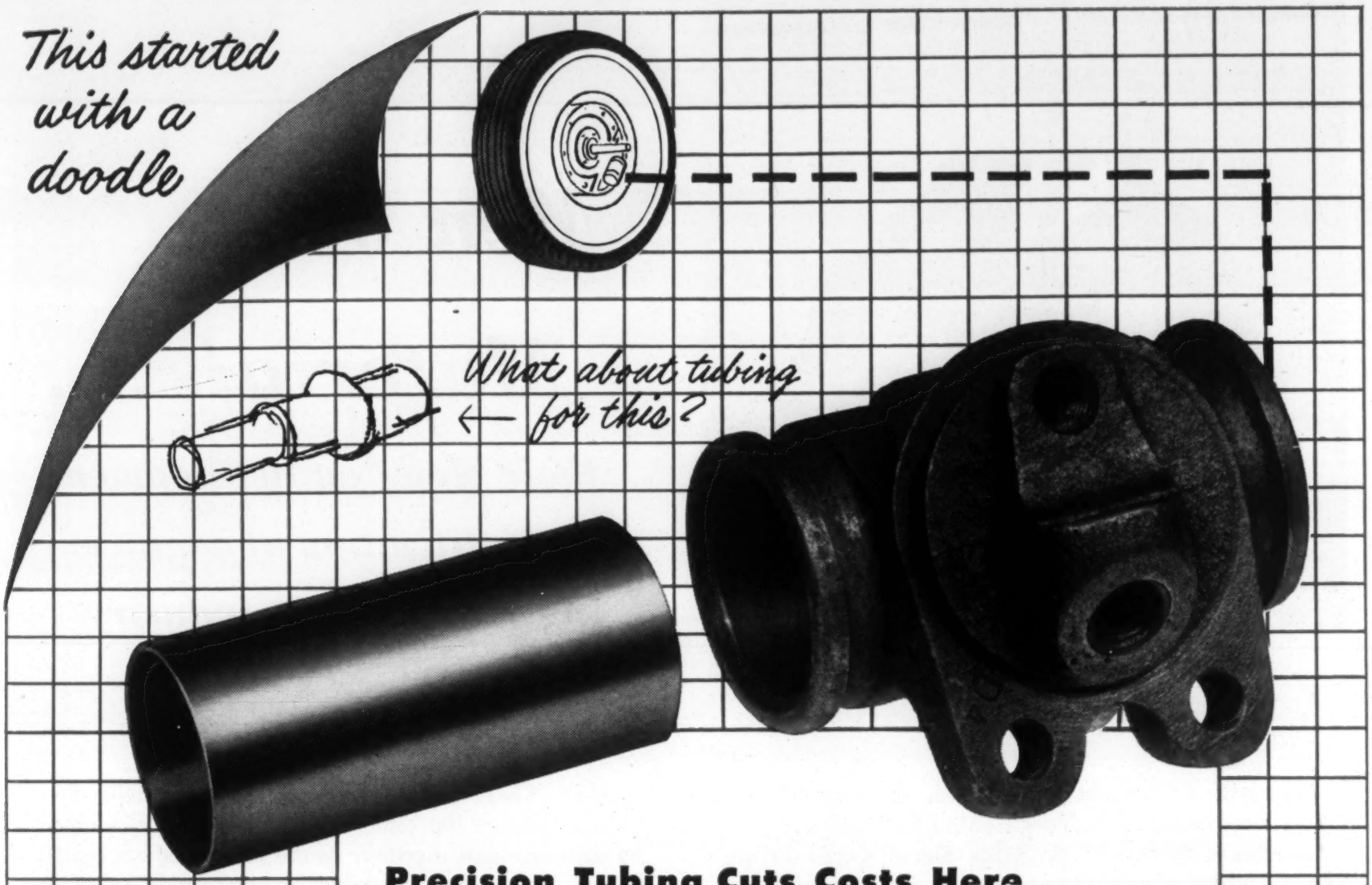
In 1919 the Army Air Corps was formed from the Signal Corps nucleus, and J. B. Johnson stayed on with the growing service as a materials engineer. He co-authored the first complete specifications for a military aircraft, and since that time has been a dominant figure in material research for the Air Force. He founded the Materials Laboratory at Wright Air Development Center, which is now one of the largest establishments of its kind in the world, and was chief of its metallurgy branch for the four years preceding his appointment as Chief Scientist of the Aeronautical Research Laboratories at Wright Air Development Center, a position he has held for the past six months.

* * *

Mr. Johnson singles out temperature as the overwhelming problem facing designers of advanced aircraft and power plants today. He points out that in the past the only serious temperature problems were associated with the valves and pistons of internal combustion engines. These more-or-less isolated high-temperature areas exceeding the limits of materials were eliminated by such technical ingenuity as the use of sodium cooled valves. Today, the possibility of engineering solutions to high temperature problems is more limited, and temperatures have climbed to the neighborhood of 1800 to 2000 F in gas turbines. Better superalloys such as the cobalt chromes have been developed, and cooling systems have been tried, but the solution to the problem appears to be in the use of totally new materials such as the cermets. Tougher silicides and borides are under development and seem to hold the greatest promise. Cooling, according to Johnson, does not seem to offer a proper solution, as air bled from the compressor for cooling reduces efficiency.

Increased aircraft speed and performance has extended high temperature problems from power plants to the entire structure of the aircraft. Johnson points out that even the experimental supersonic aircraft would fall victim to temperature-induced creep during extended periods of supersonic flight. And at speeds he calls "hypersonic", meaning several times the speed of sound, the thermal barrier challenges almost every known structural material.

While the temperature-strength relationship in aircraft materials must seem at times to pose almost insuperable problems, J. B. Johnson approaches them calmly and rather confidently. The problems are harder, but the facilities for solving them are enormous, too. Johnson's personal experience in the use of metals in aircraft extends from the period of medium carbon steel wires which held the wings on the JN-4, to the era of ¾ in. thick machined-metal skins for the wings of the heavy bombers of 1954. A man who has been so closely associated with such progress can scarcely be pessimistic in the face of new difficulties.



Precision Tubing Cuts Costs Here —What Can it do for You?

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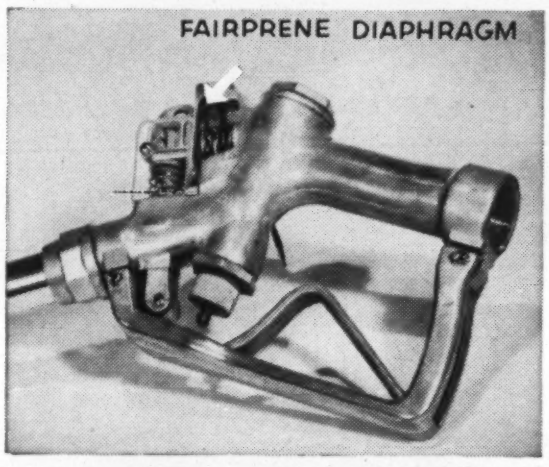

FAIRPRENE diaphragm for fuel nozzle says "when"

When a driver tells a service-station attendant to "fill 'er up," the patented "Safety-Fill" nozzle shown above automatically shuts off the fuel flow when the tank is full. This sensitive device—made by the Buckeye Iron and Brass Works, Dayton, Ohio—works through the employment of a diaphragm made of a Du Pont "Fairprene" synthetic elastic composition.

Here's how it works: When the tank is full, air escaping from the tank through a small valve into the nozzle is cut off. The resulting vacuum in a chamber causes the "Fairprene" diaphragm to jump back. This instantly stops the flow of fuel, just as the flow stops when the handle is released by the operator manually.

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The specific properties of a "Fairprene" composition will depend on the combination used, which in turn depends on the end use in view. Du Pont engineers can "tailor" these properties to fit the job. But, in general, "Fairprene" synthetic elastic compositions are resistant to petroleum oils, greases, gasoline and alcohol . . . to natural aging in air and oxygen . . . to extremes of heat and cold . . . to flex fatigue . . . to deteriorating action of fresh and salt water.

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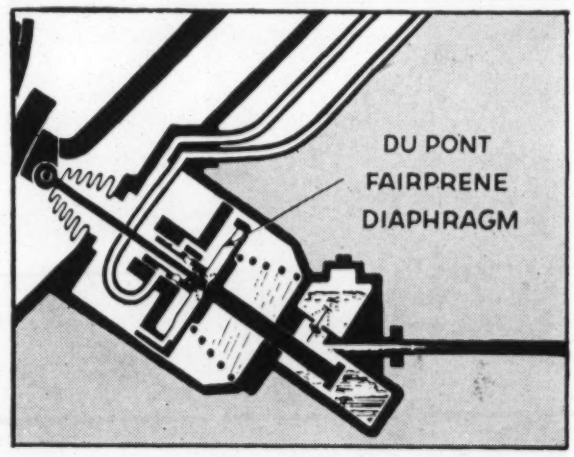
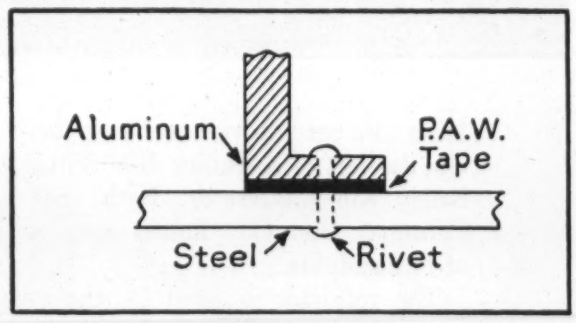


In the Bendix "Treddle-vac"® hydraulic vacuum-power brake, a "Fairprene" diaphragm controls piston action by counteracting atmospheric pressure.



"Fairprene" P.A.W. Tape seals out moisture at joints . . . inhibits corrosion . . . prevents electrolytic action between dissimilar metals.

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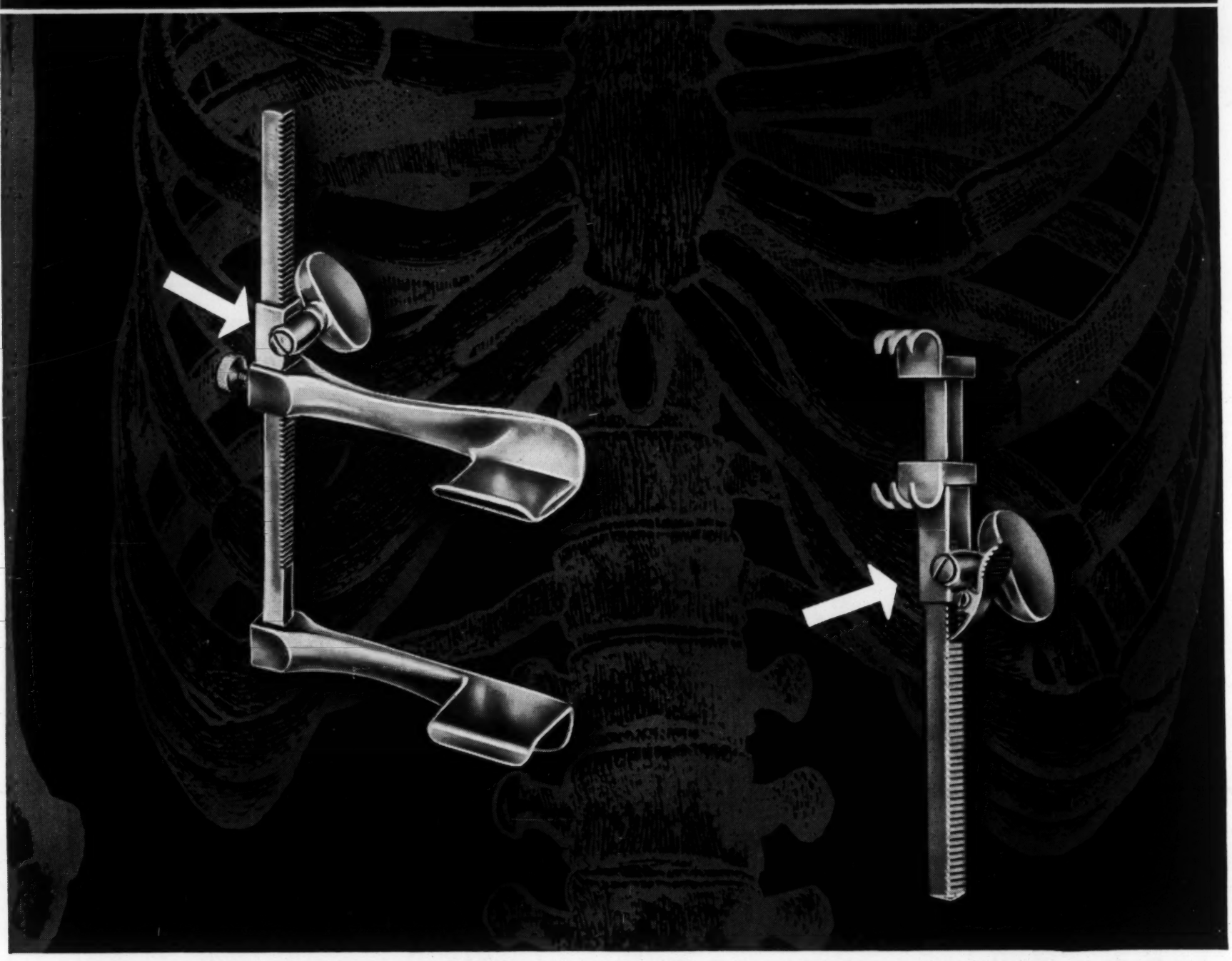
How to simplify a moving problem



It's a safe bet you've never met these two devices before. On the left is a Tuffier Rib Retractor; on the right, a Bailey Rib Contractor. Both are made by George P. Pilling & Son Co., famed surgical instrument makers of Philadelphia.

The retractor is used by the surgeon to move ribs apart; the contractor to move ribs back to normal position after an operation.

Among the many problems that cropped up in the construction of these instruments was the design of the pinion rod supports (arrows) that slide on the square racks. One solution was to broach a square hole in bar stock, but the cost was high.

Pilling discovered Superior could draw square tubing from type 304 stainless steel to the close I.D. tolerance they required. Superior stainless steel tubing resists corrosion, has no plating to wear off, silver-solders without difficulty.

Superior square tubing is only one of a wide variety of round and shaped tubing made by Superior in up to 55 analyses. And every length or coil of Superior tubing is backed by Superior tubemanship—production and research that make a real difference when you're in a jam. Superior Tube Company, 2006 Germantown Ave., Norristown, Pa.

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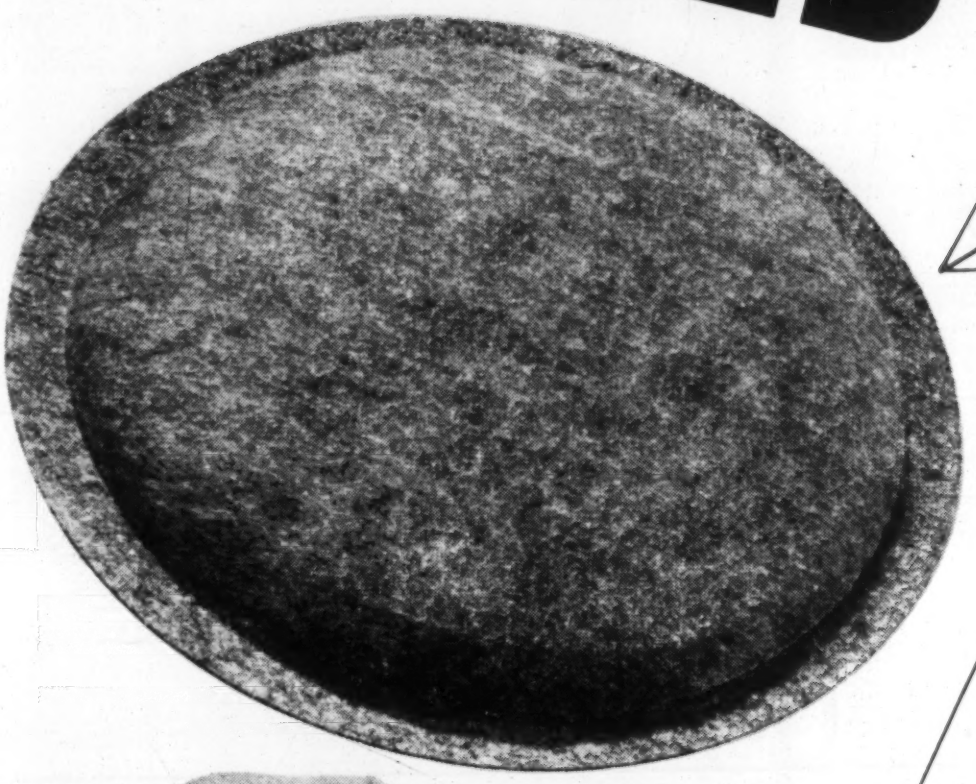
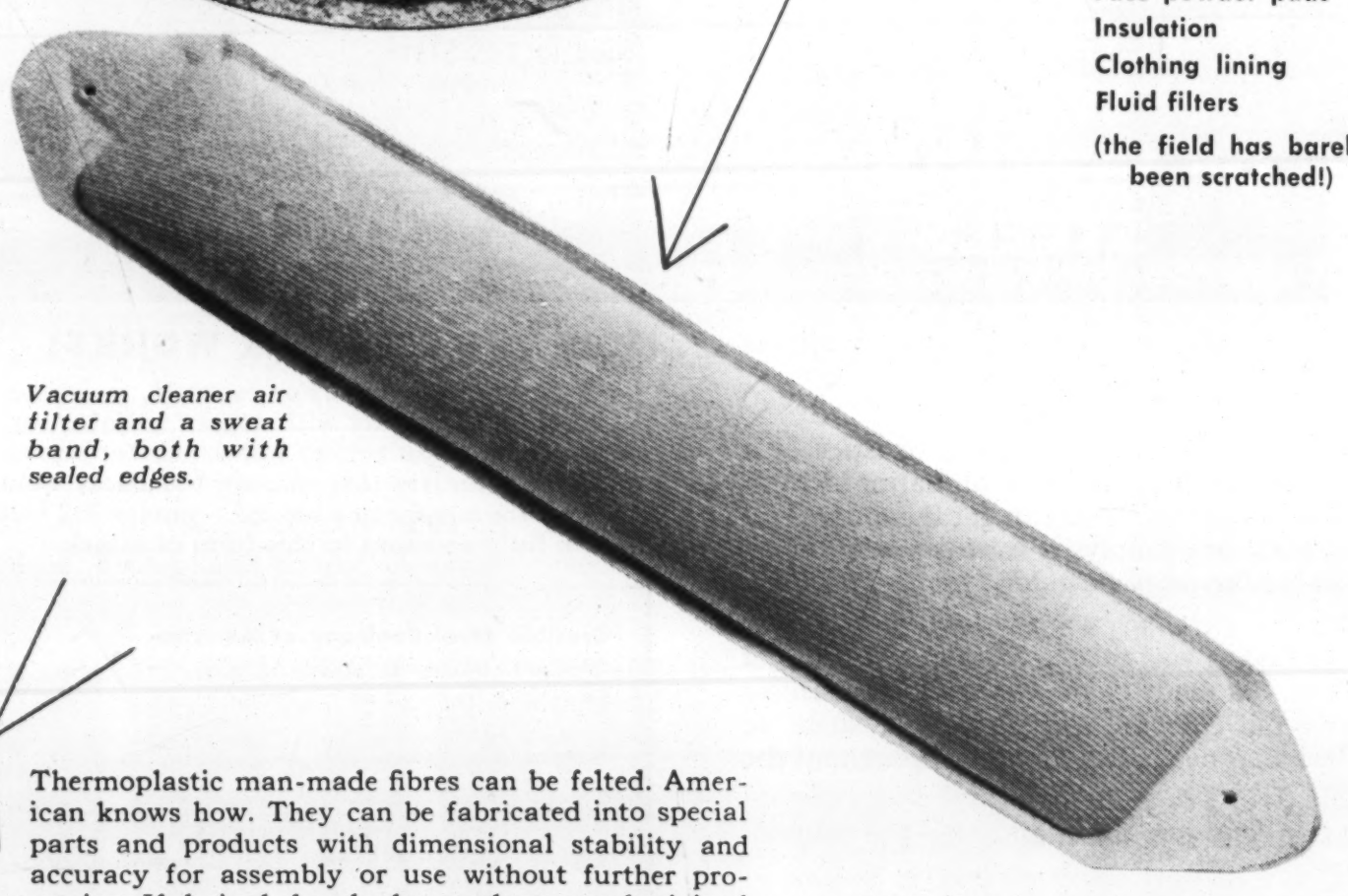


Some Present Uses

Dust shields
Vacuum cleaner filters
Powdered soap containers
Face powder pads
Insulation
Clothing lining
Fluid filters
(the field has barely been scratched!)



Vacuum cleaner air filter and a sweat band, both with sealed edges.

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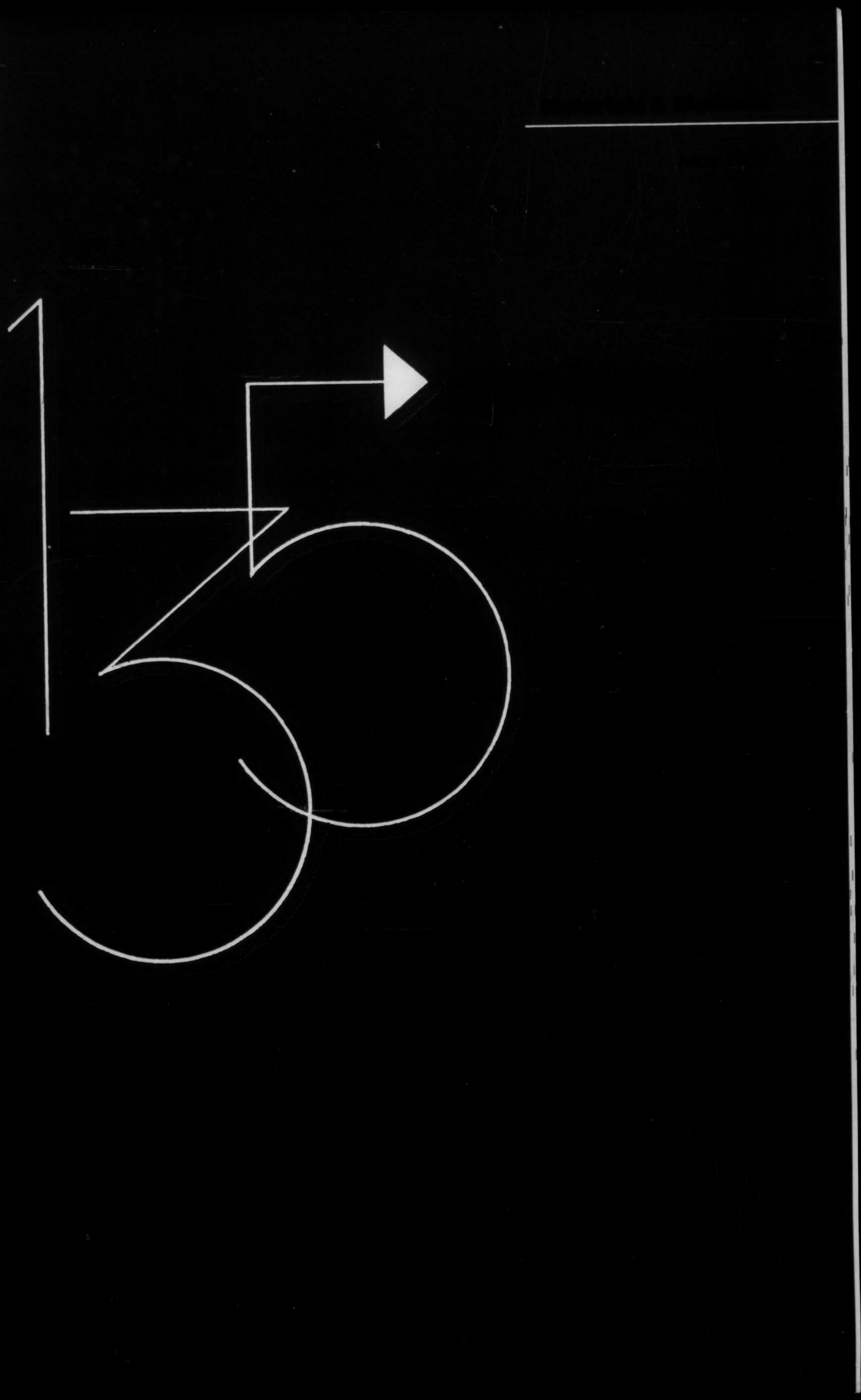


The Why and How Behind this Article

This is the first time that the entire feature section of Materials & Methods has been devoted to a single subject. In view of the increasing importance of cost in today's manufacturing picture, the editors felt that some special treatment was justified. To merely show a few examples might have been helpful; but we believed that as many case histories as possible should be presented to offer a varied selection and to prove that there is no monoply of ideas in any single industry.

It was not our intent to prove the superiority of any one material or material form. In fact there has been no attempt to see that all materials and processes are represented, although most of them are. Our chief purpose was to show a wide range of products so as to stimulate the imaginations of engineers throughout industry and to help them attack the problems of cost reduction through channels which might have been overlooked.

To secure the examples shown in this 48-page section our editors travelled more than 10,000 miles to interview hundreds of individuals. We think the results have been worth the efforts and hope that you, the reader, will agree.

May we extend our thanks to all who cooperated.

T. C. Du Mond, Editor

How Proper Materials Selection and Use Leads to Cost Reduction

Cost reduction in product manufacture is always desirable, but today it becomes more than desirable —it becomes essential. A return to stiff competition in civilian goods means that prices must be reduced or that quality must be improved without a corresponding price rise. Whether it be a purchase for personal or business needs, the buyer today is looking for more value for his money.

The same economy pressures that are dominating civilian markets are being felt in the manufacture of such military goods as aircraft. In the case of planes the vast increase in manhours required to build a complicated bomber or fighter makes necessary a thorough search for each and every way of saving money, no matter how insignificant.

Production costs can be reduced in many ways. Some methods are readily apparent. Greater output per man or machine by better tooling or automatic devices is one method that is being exploited. Better control over processes to reduce scrap loss and the salvage of rejected parts is also widely used. Another way of saving money is to reduce materials handling to a minimum. All of these steps can be roughly grouped as mechanical methods of controlling costs.

On the other hand, there are methods of reducing costs that are not so readily apparent. These methods could be grouped under the general heading of materials utilization, and to date have been least exploited.

It is a simple matter to shift from one material to another that is cheaper. However, it takes imagination and engineering ingenuity to change from one material to another, or from one material form to another and at the same time maintain quality and reduce costs. Such changes are being made every day. Indeed, in many instances not only are costs reduced but quality is actually improved.

In developing this presentation, we have chosen to restrict ourselves to those case histories in which direct savings were realized in the cost per piece of the parts described. Many other examples could have been shown in which indirect savings were achieved through better materials utilization. There are countless instances were a slight increase in cost of materials for a product doubled, tripled or quadrupled service life to result in considerable savings for the ultimate user. Examples of that nature have been omitted from this discussion because the problems involved and the approaches to their solutions are entirely different. An article of equal length could well have been devoted to that subject alone. Savings of the latter type are realized by the ultimate user. The purpose of our presentation is to show how manufacturing costs can be reduced by the judicious use of available materials and fabricating methods.

As an example of the effectiveness of seeking ways in which the use of materials and material forms can reduce costs, we can cite one ordnance item which will be described in greater detail in the case history section to follow. As originally designed, it cost $60 to machine the part from bar stock. By changing from a machined part to one made from formed tubing, cost was reduced to $5 per piece. Even with this tremendous saving, there was no impairment in quality.

Often it is difficult to convince oneself that the expenditure of a considerable sum of money to shift from one method to another will actually save money in the long run. There are many cases to prove that the doubling or even tripling of tooling costs have made possible spectacular savings in cost per piece of the products involved. On the other hand, it is not always necessary to change tooling or to make any expenditures to reduce costs. In fact, a majority of the case examples to follow did not require any major expenditures and many of the changes described resulted in a lowering of tooling costs as well as lower ultimate costs.

So important has become the problem of better materials utilization that many companies have extensive enginering staffs that do nothing but search for methods of using materials more economically. When they become acquainted with a new fabricating method they seek out possible applications within their areas of responsibility. In other plants committees have been formed to meet periodically and investigate the possibilities of reducing costs. Unfortunately, a vast majority of plants make no formal attacks upon problems of this nature. In these cases, improvement comes about more or less by accident or because of the persistance of vendors of materials and new processes.

No industry is immune to savings through the better use of enginering materials. In the examples published here we find representative products ranging from toys to machine tools, from business machines to aircraft and from tiny instruments to huge locomotives.

3 Ways to Reduce Costs

There are three major approaches to the problem of reducing product costs through better materials utilization. They are:

1. The actual choice of material.
2. Selection of the form in which the material is to be used.
3. Better design to take full advantage of the materials' properties.

In addition to the three major approaches, several less direct steps might be taken. For example organic finishes, porcelain enamels or other types of coatings might be applied to a low alloy steel, or a thinner gage of material to meet specific service conditions at lower cost. Often changes involve all three major steps. A new material might be used in a completely different form than had been the practice previously, and the use of that form might require—or make possible—some design modifications, all of which might contribute to the over-all cost savings.

Savings Through Materials

Immediate savings can often be realized through the simple expedient of changing from one material to another, without making any other substantial change in form or in processing methods. For example, in recent years there has been considerable shifting among zinc, aluminum and magnesium for die castings. Granting that there are no specific considerations that would make one material essential, these three materials can be used for many of the same parts and often in the same die. The final choice would be made on the basis of cost alone.

Low alloy or carbon steels can often be used for applications in which high alloy steels have previously been the choice. Sometimes the change can be made without any other variations from previous practice. In some instances a simple coating process is sufficient to make an inexpensive material serve where expensive materials had previously been used. Another variation of this approach is to use low alloy steels for their ease of forming and then carburize them or give them other heat treatments to meet service requirements.

Many plants have been prone to order materials, particularly metals, to special sizes and conditions of temper or finish. A shift to standard mill sizes and conditions will often save money even though some treatments might be necessary in the using plant after fabrication. Plastics and other non-metallic materials often replace metals with resultant cost reductions and often with improved service characteristics. Most non-metallic materials cost more per pound than do metals, particularly steel; but because they are lighter in weight, there is a good chance that they will cost less on the basis of volume.

Savings Through Form

Probably the greatest possibility for costs saving lies in a change of fabrication or in the form in which the material is used. In many cases, complex structures which could only be made through expensive machining or forming methods are broken down into simple components that can be made from sheet, plate or simple cast or wrought forms and subsequently joined to form the complex shape. Conversely, it has been found that with some forming methods, it is possible to combine several simple shapes into one casting or extrusion, eliminating needless assembly costs.

Some of the expensive forming processes can be justified because they do reduce ultimate assembly operations and bring about a net reduction in costs. Others can be justified because they overcome the need for extensive machining. Machining is one of the most expensive processes today; thus if it can be reduced to any appreciable extent, a substantial saving should result. Many of the newer forming processes have as their chief advantage the fact that they can produce parts to closer tolerances and to better finishes. Those processes which offer new possibilities are closed die forging, investment casting, shell molding and powder metallurgy.

Just coming into its own, as a cost saving production method, is extruding. Once limited to some of the softer nonferrous metals and to certain non-metallics, extrusions are now possible in high strength alloys, including steels and some of the high temperature alloys. It is not uncommon to find that savings of as high as 65 per cent per piece are realized through the use of extruded shapes.

Often overlooked is the use of tubing rather than bar stock for many parts which would normally be machined from the solid. As one supplier of mechanical tubing puts it "Why pay for the hole?" Tubing is, of course, best suited for parts with relatively large internal openings.

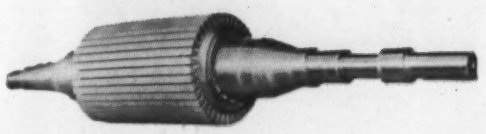
Savings Through Design

When changing from one fabricated form to another, design changes are often required. However, there are opportunities for saving even when the same basic design is retained. For example, for many years designers have been using considerably more material than is necessary on many parts by following the old margin of safety rule which is rapidly becoming obsolete. As more information becomes available on materials, and with the perfection of new nondestructive testing techniques, it is not necessary to double or quadruple section thicknesses to assure a sound design. As a matter of fact, throughout the aircraft industry intensive studies are being made to see where and how castings can be lightened. Redesigned castings not only achieve the desired weight saving for aircraft use, but also lower costs of the parts.

It is also possible to use thinner sections generally if reinforcing webs are used wisely. The matter of radii is one that is often overlooked as a means of saving material. In one example shown later, the use of a more generous radius on the outside edges of copper bus bar saved an enormous quantity of metal. At the other extreme less generous radii on internal sections of castings can also save material and money.

Although not fully exploited yet, another use of design to reduce costs is in the trend toward miniaturization. Generally speaking, miniaturization is finding its most fertile grounds in the making of electrical and electronic components. However, the same general ideas can be used in larger equipment such as in electric motors which have undergone complete redesign in recent years to make them smaller, more compact and more powerful. A huge savings in materials has been a side effect in this case, but it shows what can be done.

The case histories shown on the following forty-odd pages are presented not necessarily as outstanding or unusual examples, but are intended to be typical of what can be done. They are presented to stimulate the imagination of the engineer in the hope that they will suggest ways in which he can meet current demands to bring costs into line.



Motor Shaft

Shaft for 30-frame, 2-pole induction motor must be large enough to prevent excessive vibration with a small degree of rotor unbalance.

Old Shaft of 8-in. dia machined from Class E forging (ASTM A 235).

New Shaft of 7¾-in. dia machined from forged SAE 1035 steel bar which, at the time of redesign, was available in unmachined diameter up to only 8 in.

Savings 67% reduction in cost of material, since the new material cost only $.08 per lb compared to $.24 per lb for the old. Vibration tests showed the shaft diameter could be reduced without introducing vibration or balance problems.

Source: *Westinghouse Electric Corp.*

1

Automatic Washer Basket

Spinner basket for "Laundromat" automatic clothes washer. Must resist corrosion by hot aqueous alkaline solutions and abrasion by action of clothes over period of years.

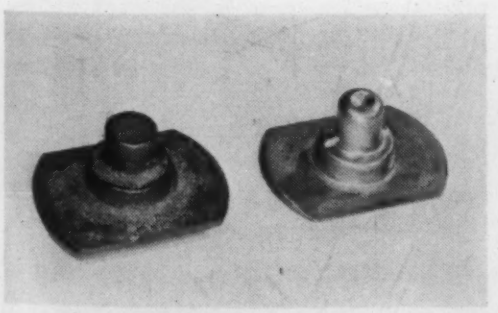
Old Conventional enameling iron with vitreous enamel coating.

New SAE 1010 cold rolled steel with vitreous enamel coating (tests showed quality equivalent for this part).

Savings Approximately 5.5%, resulting from lower cost of base metal.

Source: *Westinghouse Electric Corp.*

2



Heater Plate

Heater plate for automatic coffee maker; flat with boss; long dimension about 2 in. Must have good heat transfer qualities, dimensional accuracy, absense of flaws, porosity and other factors that might cause leakage.

Old Brass casting, weighing 0.427 lb per piece before machining (left).

New Brass forging produced from a blank by hot-pressing (right). Weight per piece, 0.286 lb before machining.

Savings About 20%. Savings attributed to: machining reduced 14%; scrap reduced from 40% to 2%; tool life greatly increased. Elimination of surface machining minimized warping. Switch to forgings practically eliminated leaks encountered in castings.

Source: *Copper & Brass Research Assoc.; Landers, Frary & Clark*

3

4

Shroud Cover

Covers power turbine unit and confines cooling air passing over enclosed gear box. Approximately 15 x 11 x 4 in. Must withstand reasonable aircraft vibration and shock.

Old 3S-O aluminum stamping, drawn to shape.

New Glass fiber reinforced polyester resin, 0.080-in. thick. Lay-up molded with aluminum sleeve molded into neck.

Savings Reduced cost due to limited production which greatly increases per-part tooling costs for aluminum stampings.

Source: *Fairchild Engine & Airplane Corp., Stratos Div.*

5

Airframe Parts

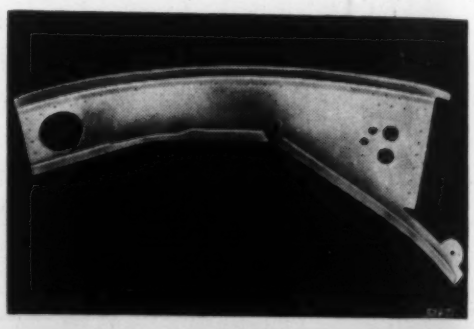
Structural parts which must have high yield and tensile strength, good workability and corrosion resistance.

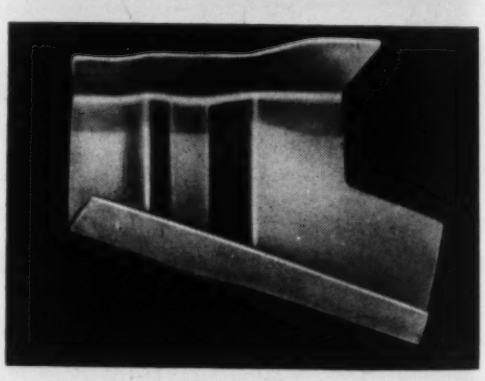
Old Type 301 half-hard temper stainless steel.

New Type 17-7 PH (precipitation-hardening) stainless steel.

Savings Fabrication cost reduction due to improved workability since 17-7 PH can be worked in fully annealed condition and heat treated after fabrication. Also obtained 50-90% increase in yield strength and 23% increase in tensile strength.

Source: *Armco Steel Corp.*





6

Spacer Block

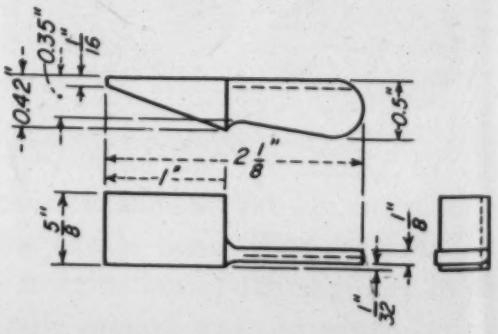
Supports skins at leading edge of aircraft inboard flap where extension of rib is impractical. Dimensions: 2⅛ x ⅝ x ½ in. Only lightly loaded.

Old Machined from 75S-T6 aluminum alloy bar stock.

New Investment cast of 356-T6 aluminum alloy.

Savings Approximately 50%, resulting from elimination of numerous machining operations.

Source: *The Glenn L. Martin Co.*



Fire Detector Thermocouple Insert Cup

7

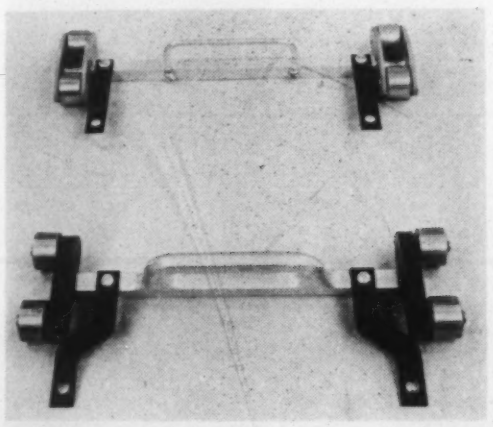
Part is about 0.75 o.d. x 0.20 in. high. Must meet very close tolerances and sharp corners as seen in attached drawing.

Old Screw machine product. Was not satisfactory dimensionally, and the manufacturer had difficulty in meeting production schedules.

New Stamping made from Type 347 stainless steel.

Savings Better than 10%, attributable to new method of manufacture.

Source: *Worcester Pressed Steel Co.*



Pressure Roll Tie Bar

8

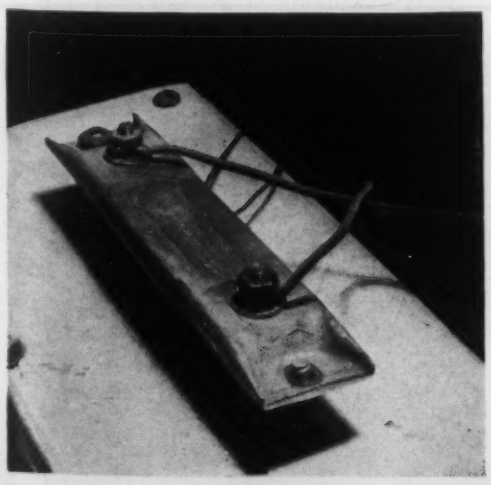
Part is used on the card feed mechanism of a card punch machine. Must feed cards uniformly and without marking. Must have good appearance and ease of assembly.

Old Machined and formed steel parts. (top)

New Aluminum die casting with inserts and plastic molding with inserts. (bottom)

Savings 45%, attributed to simplification of assembly and replacement of machined parts with die castings and plastic molding.

Source: *International Business Machines Corp.*



Electric Strip Heater Casings

9

Made of rectangular tubing approximately ½ in. high by 1-½ in. wide, having a wall thickness of about 1/32 in. and varying in length from 7 to 35-½ in. Operates in the temperature range around 1200 F. Material must be able to undergo severe cold forming (crimping) during assembly and stamping for identification.

Old Type 430 stainless steel tubing.

New SAE 1010 steel, chromized on the inside and outside.

Savings Estimated at 20% on material cost. Fabrication of 1010 is also easier on the tools and faster.

Source: *Chromalloy Corp. of New York*

10

Bus Bar

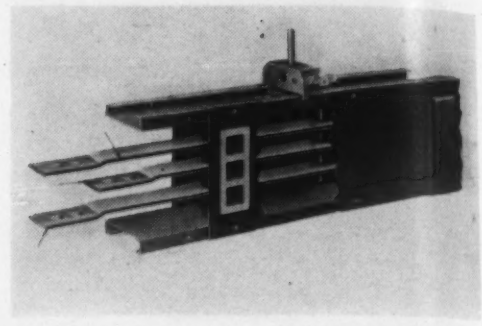
Bus bar used in bus duct is ¼ in. thick and may be from 1 to 6 in. wide. Must have high electrical conductivity, be suitable for butt brazing, and allow contact stabs to slide over the edge.

Old ¼-in. thick bus bars with 1/16-in. radius on edges.

New Same material with ⅛-in. radius on edges.

Savings Reduction in cost of material resulting from the use of 40 lb less copper per 1000 ft of bus bar.

Source: *Westinghouse Electric Corp.*



11

Automotive Muffler

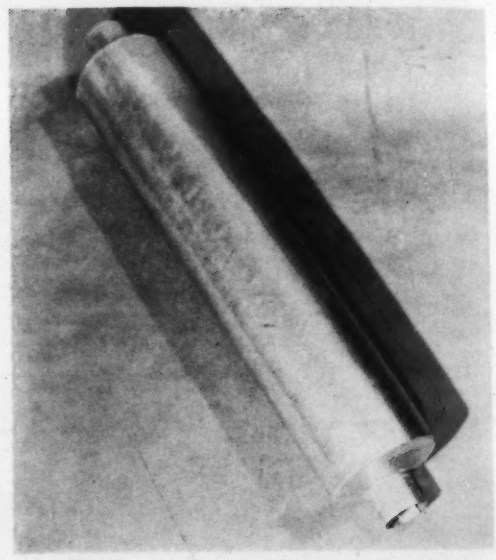
Truck or bus muffler, approximately 34 in. long, 8 in. in dia and aluminum painted for the sake of appearance. Muffler, in addition to cutting down noise, must withstand heat and corrosive gases in the range of 1300-1400 F, rust and pitting due to attack by abrasive oils and gravel from streets.

Old 436 stainless steel containing 16% chromium.

New 1010-1020 cold rolled steel ceramic coated (with A-19).

Savings 61%, resulting from use of ceramic coating which permits use of lower cost carbon steel. In addition to cost savings, life expectancy of the muffler is prolonged five times on the basis of mileage.

Source: *Bettinger Corp.*



12

Automobile Radiator Fins

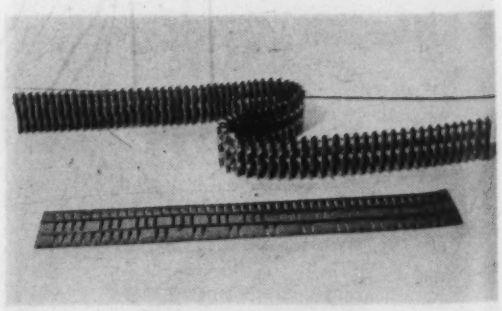
The primary requirement for radiator fins is corrosion resistance. Heat conductivity is important, material must be solderable to be attached to copper tubing.

Old Flat stamped copper 0.0041 in. thick, 24 in. long. The part was mounted in the radiator horizontally.

New Corrugated stamped copper 0.003 in. thick, about 8 ft long. This fin is mounted vertically (top).

Savings The thinner copper, corrugated for strength, gives more surface area and better cooling while reducing the amount of copper used and cutting down on the number of fins assembled in the radiator. The new fin cuts down assembly time, saving labor, and is easier to stack since the corrugated fins interlock and will not slip around.

Source: *Ford Motor Co.*



Lock Knob For Earphone Headset

The assembly is a component of earphone headsets used by the Signal Corps; unit allows the size of the headset to be adjusted; part must be corrosion resistant to withstand weathering and perspiration.

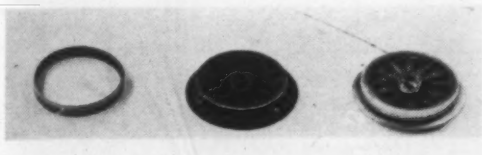
Old Three brass parts had to be machined, threaded, knurled, milled, deburred and plated (top).

New Plated brass sintering with screw machine insert.

Savings 82%. Operations on main components were reduced to three: pressing, sintering, plating, all of which are amost entirely automatic. Additional part is easily made on ordinary screw machines. Scrap loss, previously high with expensive brass, was completely eliminated.

Source: *Lionel Corp.*

13



Model Train Drive Wheel

Wheels are mass produced by the million, must be wear resistant.

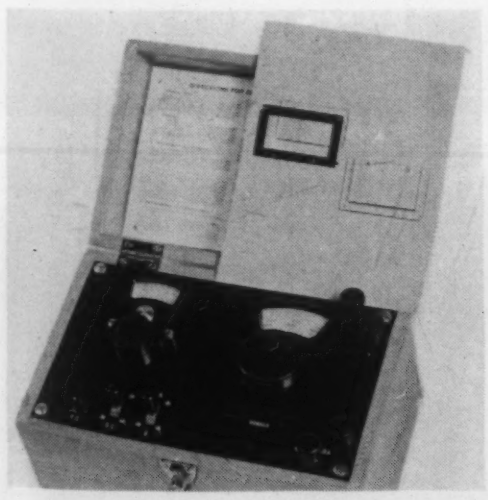
Old Zinc die casting with steel tire required nine separate operations: Wheel was die cast, trimmed, turned, heat treated, plated. Tire was cut from tubing, deburred, plated. Two parts had to be assembled.

New Powdered iron, pressed, sintered, and blackened.

Savings Scrap loss eliminated, entire process automatized, tooling cost lowered, material cost reduced by 30%, total cost reduced 68%.

Source: *Lionel Corp.*

14



Instrument Dial Window

Window forming protective covering and providing cross-hair for calibrated reading dial on portable instrument. Fits into slot in molded top plate of instrument and is held in place by four screws from the under surface of the plate. Must be adapted to easy and accurate assembly.

Old Two-piece assembly of (a) light-gage brass frame, about 2 x 1¼ in., with four punched screw holes, cross-hair of fine brass wire soldered in place, and black lacquer finish, and (b) panel of good-grade window glass, about 1¾ x 1 in.

New One-piece Plexiglas (methyl methacrylate) molding, equal in size and thickness to the former two-piece assembly, and having screw holes and cross-hair molded in.

Savings 18 cents (about 47%) per part for small production lots; larger savings for longer runs. Savings attributable to elimination of forming and joining operations on frame and to simplified assembly.

Source: *Leeds & Northrup Co.*

15

16

Evaporation Tray

Used in bottom of "Frost-Free" automatically defrosting refrigerator. Defrost water drains down back of refrigerator into tray and is subsequently evaporated. Tray must be impervious to water and resist corrosion caused by prolonged contact with water. Must also resist warping and have moderate impact-resistance.

Old Polyester-glass reinforced plastic formed at low pressures on matched metal dies.

New High-impact polystyrene, either molded or post-formed from sheet by drawing.

Savings Approximately 53%, resulting from (a) lower cost of material and (b) lower labor costs caused by simpler fabrication techniques.

Source: *Westinghouse Electric Corp.*

17

Aircraft Nose

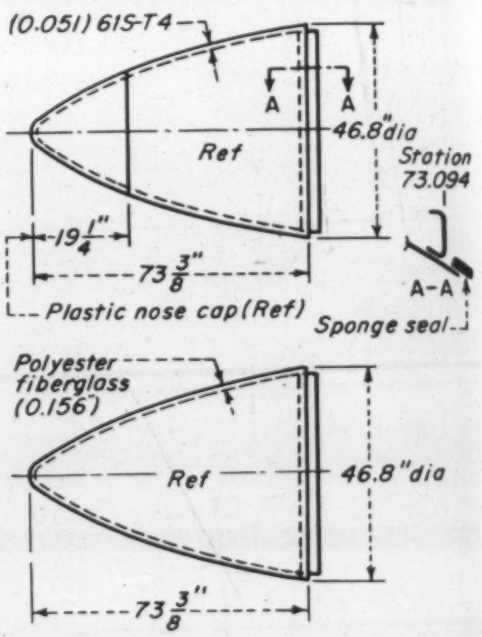
Skin assembly about 6 ft long, pointed at one end and about 4 ft in dia at the other end. Must be aerodynamically smooth, and rigid enough to resist buckling under air loads.

Old Spotwelded assembly of 0.051-in. 61S-T4 aluminum alloy sheet joined to small nosetip of molded polyester-glass fabric (top).

New One-piece structure of polyester-glass made on unheated low-pressure matched molds (bottom).

Savings Approximately 55%, resulting from reduction in number of detail parts and in cost of assembly.

Source: *The Glenn L. Martin Co.*



18

Chafing Dish

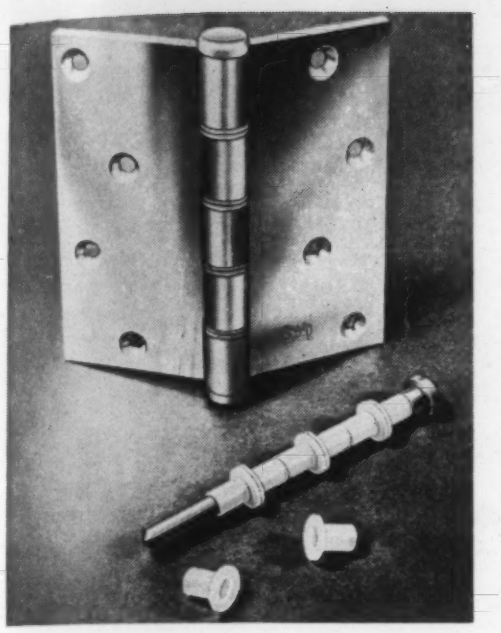
Water pan, food pan and cover, each about 9 in. in dia. Must have high thermal conductivity, resist corrosion by foods handled, and avoid harmful or undesirable contamination of food. Natural copper appearance considered desirable for consumer appeal.

Old Formed from copper sheet or strip. Inside surfaces tinned.

New Formed from copper-clad aluminum.

Savings Attributable to 35% reduction in cost of material and to elimination of tinning operation. Change also desirable because heavy layer of aluminum never needs refinishing, whereas tin-lined vessels require retinning after some use.

Source: *General Plate Division of Metals & Controls Corp.*



Hinge Bearing

19

Bearings for butt hinges available in sizes ranging from 3½ to 6 in. Must be corrosion resistant, require minimum maintenance and resist wear over a long period of time.

Old Conventional machined steel ball bearings.

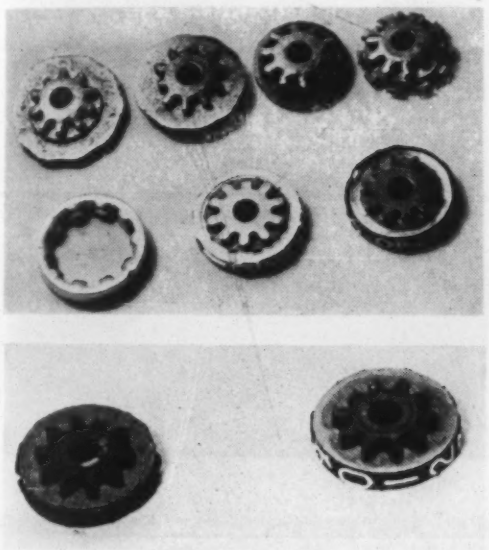
New Molded nylon sleeves with integral flanges.

Savings Manufacturing cost information unavailable, but hinge sells for 15% less than comparable ball-bearing hinge and offers the following improvements:

1. All knuckles bear, not just two as in some ball-bearing hinges.
2. Thinner bearings permit thicker, stronger barrel.
3. Better weather resistance and far longer wear life.
4. No binding or squeaking.
5. No lubrication needed.

Cost savings attributable to elimination of ball bearing machining operations and to simplified assembly.

Source: *H. S. Getty & Co., Inc.; E. I. DuPont de Nemours & Co., Inc.*



Accounting Machine Numbering Wheels

20

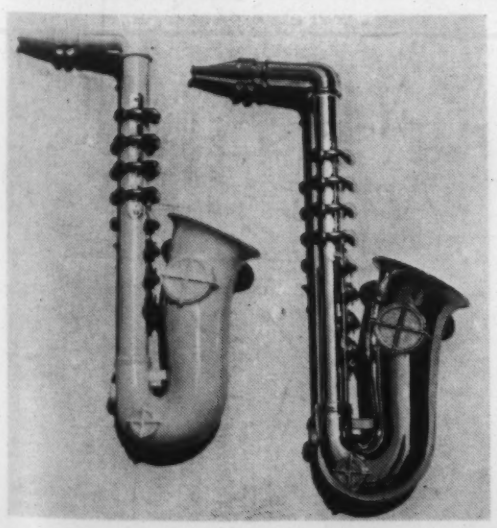
Wheels are 0.430 in. dia, 0.0995 in. thick, with 10 tooth gear on one side. Requirements: Clean outline of numerals; close tolerance on width; excellent and accurate gear tooth outline.

Old Two steel shapes machined to size and pressed together. Photo (top) shows steps required. Top row shows production steps on gear. Lower row shows wheel rim and assembly operations.

New One piece molded nylon. (Lower photo)

Savings 10%. Expensive machine operations and assembly operation eliminated.

Source: *Remington Rand, Inc.*



Toy Saxophone

21

Must have eye appeal, golden metallic color.

Old Injection-molded of yellow-pigmented virgin polystyrene (left).

New Injection-molded of scrap high-impact polystyrene, metallized with aluminum, and coated with yellow-dyed lacquer (right).

Savings Approximately 50%, resulting from reduction in cost of plastic. Change also desirable because of more realistic metallic appearance achieved.

Source: *F. J. Stokes Machine Co.; Harmonic Reed Corp.*

22

Vise Guide

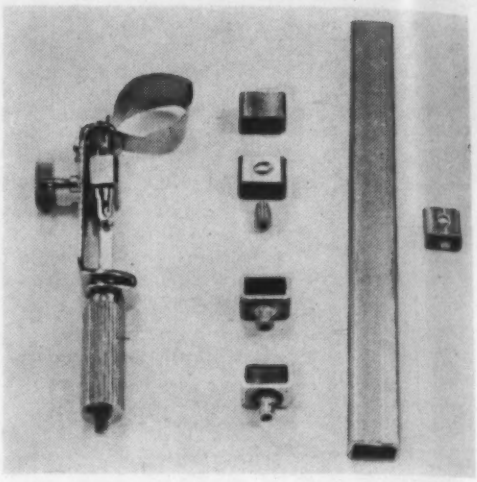
Used in dental matrix holder. Dimensions: ⅛ x ¼ in. internal rectangular cross-section, ¼ in. long, 0.028 in. wall thickness. Threaded tightening hole for thumb-screw mounting on one ¼-in. flat. Vise must be easily sterilized and resist pitting and corrosion in strong sterilizing solutions.

Old Stamping from Type 420 stainless steel sheet bent and formed to rectangular cross-section shape, soldered, blanked, deburred, heat treated and hand-polished.

New Rectangular-shaped, welded and drawn Type 420 stainless steel tubing of the specified inside diameter and thickness, cut to length, drilled and tapped for thumb-screw mounting, heat treated to Rockwell C48 minimum and assembled into finished matrix.

Savings 8 to 10 cents per vise, resulting from elimination of six forming, joining and finishing steps in former manufacturing cycle.

Source: *Superior Tube Co.; J. W. Ivory & Co.*



23

Latch Cam

Part is used in retrievable gas lift valve. Must be corrosion resistant, withstand high pressure, maintain shape, and resist galling, shock and abrasion.

Old Machined, drilled and finished from bar stock.

New Precision cast monel ("S"), plus drilling and lapping.

Savings About 84% saved through elimination of machining operations.

Source: *International Nickel Co., Inc.*

24

Steam Trap Body and Bonnet

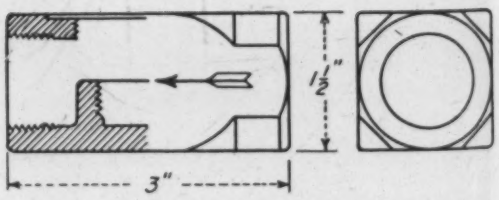
Made from square and hexagon bar stock. Primary requirement is resistance to steam erosion and corrosion.

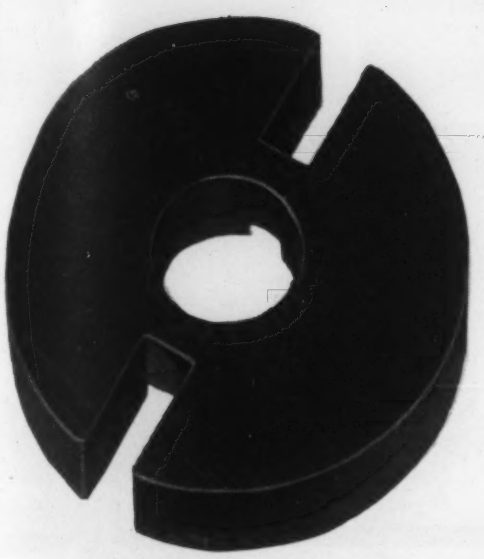
Old Stainless steel is the standard in the industry because it forms a coherent oxide film, resistant to steam at high velocity.

New A chromized case on ordinary free-machining steel (1117 steel) produces same result.

Savings Depending on the size of the parts, savings vary from 7.8¢ to 60¢ per piece on a straight material basis allowing for freight costs to and from processing plant. Ease of machining and availability are also important factors.

Source: *Chromalloy Corp. of New York*





Oil Pump Rotor

Used on business machines. Must meet tolerances of ±0.001 and 0.002 in.

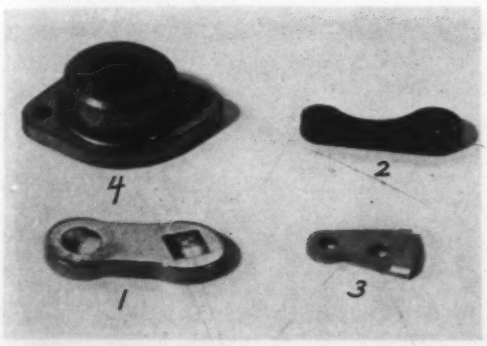
Old Machined from B1113 screw machine steel.

New Noncarburizing iron-copper powder, pressed and sintered. Composition: 88.2 iron (min), 5.0 to 11.0% copper, minimum impurities (limited to 0.3 carbon, 0.3 silicon and 0.2% aluminum).

Savings Approximately 84%, resulting from elimination of machining operations.

Source: *F. J. Stokes Machine Co.; International Business Machines, Inc.*

25



Business Machine Parts

1. Accounting machine tie link: 1.250 long, 0.500 wide, 0.125 in. thick. 2. Accounting machine connecting link: 1.000 long, 0.375 wide, 0.125 in. thick. 3. Tabulator hammer split pawl: 0.687 long, 0.406 wide, 0.093 in. thick. 4. Sorter—lever roll bearing: 0.750 hub dia, 0.375 in. hole. All four parts require accurate outline and close hole dimensions.

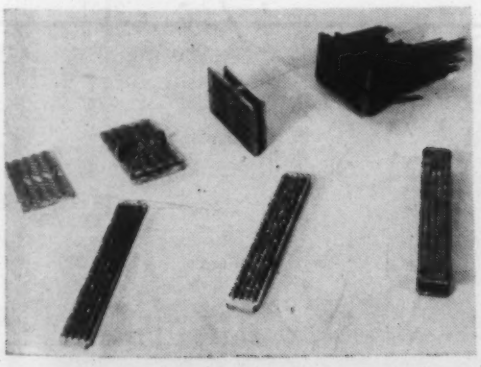
Old 1, 2 and 3: Cold rolled steel. 4: Cold rolled steel hub with bronze bearing.

New 1, 2 an 3: Sintered iron powder. 4: Sintered bronze powder.

Savings 25%. Attributed to elimination of expensive machining operations.

Source: *Remington Rand, Inc.*

26



Cable Retainers

These two wiring unit cable retainers are made in two sections and fastened together. The upper cable retainer (top) has 180 0.072-in. holes, 0.090-in. apart. Lower cable retainer (bottom) has 240 0.072-in. holes, 0.090-in. apart. Holes must be accurately located and accurate tapping required for holding cables. Rigidity also required.

Old Upper retainer made of a 0.042-in. thick cold rolled steel and a 0.093-in. brass plate. Lower retainer made of a 0.093-in. cold rolled steel plate and a 0.093-in. brass plate.

New Zinc die castings.

Savings 50%. Die castings eliminate drilling operations. Ten plates cast per machine in production.

Source: *Remington Rand, Inc.*

27

28

Brake Bracket

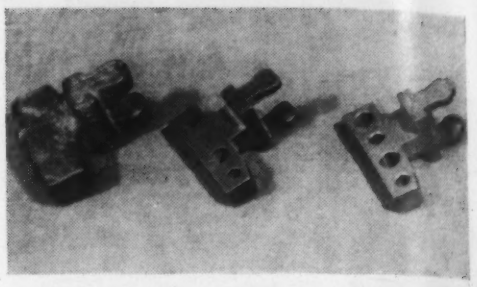
Rough dimensions, 2.5 x 2 x 1.5 in. No critical requirements.

Old SAE 8740 forging machined to finished dimensions.

New SAE 4140 investment casting.

Savings 40% due to the reduction in machining which offset the increased cost of the casting.

Source: *General Motors Corp., Allison Div.*



29

Compressor Stator Blade

For the J-35 Allison jet engine, blades varied in length from approximately 4½ in. for Stage 1, to 2 in. for Stage 13. Blades must withstand impact and not fail in fatigue.

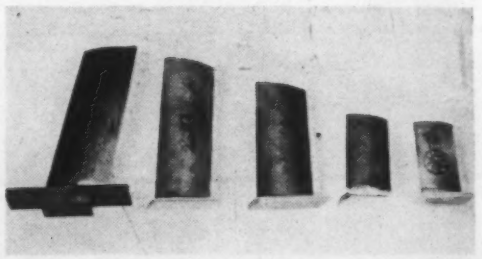
Dimensional Tolerances:	
Width	±0.008 in.
Thickness of airfoil	±0.003 in.
Contour of airfoil	±0.005 in.
Straightness of airfoil	±0.005 in.
Twist	±½ deg
Mechanical	
Yield point	75,000 psi
Tensile strength	100,000 psi
Elongation	6%
Rockwell B hardness	90-95
Bending angle	120 deg

Old Forged Type 403 stainless steel.

New Copper-infiltrated reduced iron powder.

Savings Approximately 50%, attributable to less handling and labor of metal powder part as compared to forging.

Source: *American Electro Metal Corp.*



30

Spray Nozzle

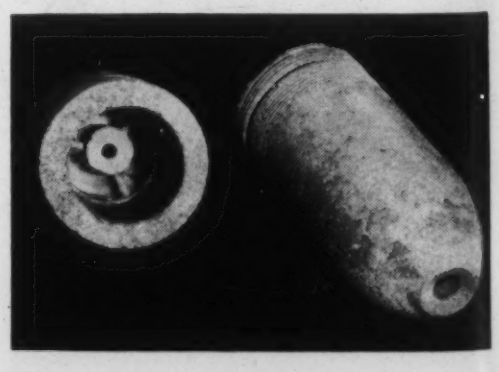
Nozzle handles corrosive acids at 150 F inside, hot gases at 650 F outside.

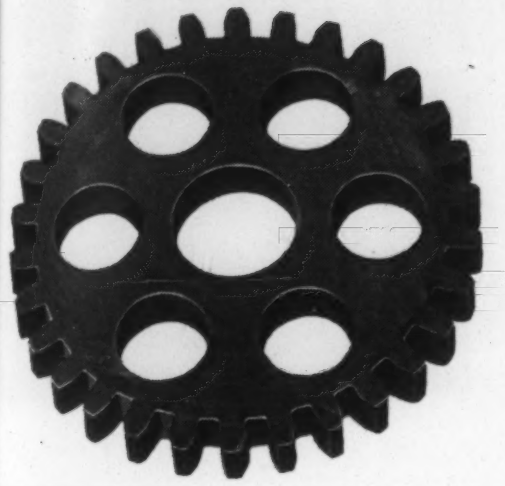
Old Cast 8% antimonial lead.

New Bonded silicon carbide.

Savings Lead alloy lasted 3 months, cost 25% more than silicon carbide which is still in service after 15 months.

Source: *Carborundum Co.*





Washer Gear

Intermediate wringer-drive gear for washing machine. Transmits power from main worm gear spur to wringer drive gear. Must meet close dimensional tolerances.

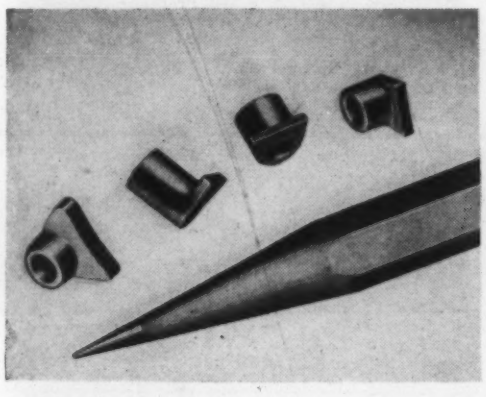
Old 3/8-in. hot rolled C1015 steel blank, pierced, flattened, machined to cut teeth, and wire-brushed to remove burrs.

New Copper-infiltrated iron powder part pressed and sintered. Composition: 22-25 copper, 1.0 max carbon, 0.3 max silicon, 3.0% max all other elements, balance iron. Properties: 7.1-7.6 specific gravity, 75,000 psi ultimate tensile strength, 1% elongation in 1 in., 95,000 psi yield point in compression, 70-80 RB hardness.

Savings 7.7 cents per gear, resulting from elimination of forming and finishing operations.

Source: *F. J. Stokes Machine Co.; Whirlpool Corp.*

31



Instrument Clamps

Four sizes of clamps as shown in photo are used in aircraft remote reading instrument. Clamps must meet close tolerances and withstand shear stresses on flanges and have good corrosion resistance.

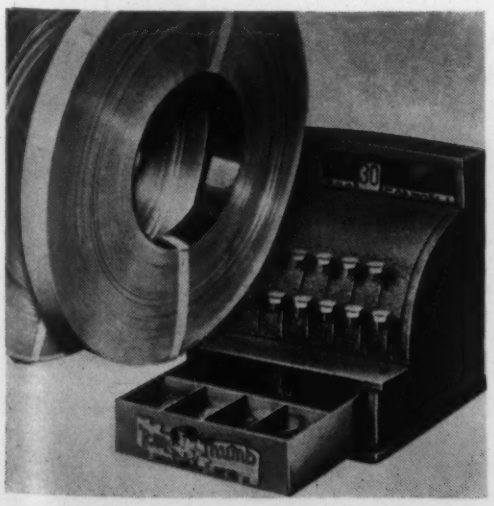
Old Made from aluminum bar stock. Parts required six screw machines plus punch press operations.

New Nickel-silver metal powder part.

Savings Sixty cents per instrument resulting from production economies. Production operations cut from six to two.

Source: *New Jersey Zinc Co.; Amplex Div., Chrysler Corp.*

32



Toy Cash Register

Drawer and drawer dividers made of thin gage steel strip painted for attractive appearance.

Old Drawers and strips fabricated from steel coil by welding then degreased and painted.

New Drawers and divider strips now fabricated from pre-coated (baked enamel) steel strip. Redesign eliminates welding.

Savings About 50%. Use of pre-painted stock eliminates cleaning and finishing operations after fabrication.

Source: *Enamelstrip Corp.*

33

34

Shaft Coupling

Used for close coupling armature shaft to gasoline engine. Part has 5⅛ in. o.d., 2¼ in. i.d., and is 1¼ in. thick. Must withstand 1800 rpm service.

Old Part completely machined from SAE 1020 steel bar stock.

New SAE 1020 plate, 13/16 in. thick, from which 5½ in. dia parts are blanked with center hole punched. Weld bead then deposited with semi-automatic hidden arc welding, and bead machined to dimensions.

Savings $0.60 per coupling, amounting to approximately $3000 per year, due to reduction in machining time, and material used.

Source: *Lincoln Electric Co.*

35

Wing Skin

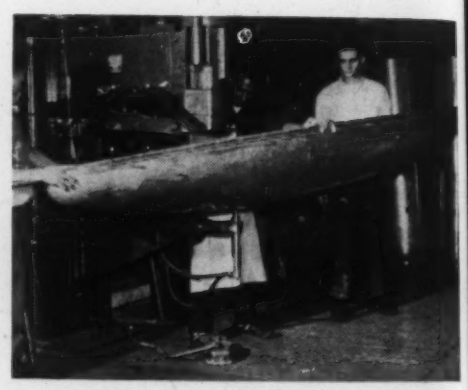
Surface of wing skin reinforced with extruded stiffeners. Must be aerodynamically smooth; all aluminum construction.

Old Drilling, dimpling and/or countersinking both skin and extrusions, followed by assembling and riveting.

New Machine spot welding.

Savings Approximately 60% due to speed of operation of spot welding and elimination of drilling, dimpling, countersinking and riveting operations. Spot welds also give more consistent aerodynamic surface.

Source: *Republic Aviation Corp.*



36

Servo Mechanism Cap

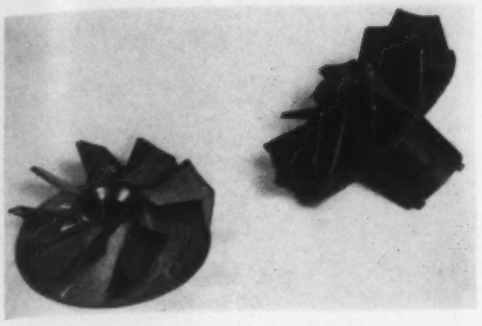
Cavity shaped part, must withstand 3000 psi hydraulic pressure. Dimensions of 0.625 x 1.420 x 2.055 in. must be held within tolerances down to ± 0.005 in. Must have neat appearance.

Old Machined from 24S-T4 aluminum bar stock.

New Precision investment cast in beryllium copper.

Savings Approximately 90% due to reduction of machining, scrap material, machine load, and use of special jigs and machining fixtures. Assures more consistent uniformity of part, and increases neatness of appearance.

Source: *Bell Aircraft Corp.*



Air Impeller

Nine vanes. Part is 3 in. dia, 1½ in. high, highly stressed. Must withstand 90,000 rpm spin test at ambient temperatures, must be dynamically balanced, and must withstand service temperatures up to 350 F.

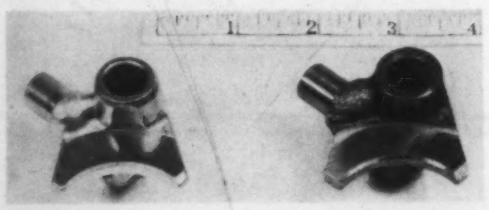
Old Vanes were milled from solid hub of 410 stainless steel, then shroud was brazed to vane ends.

New Redesign eliminated shrouds, and part is investment cast in 410 stainless steel. Right, as-cast; left, after machining.

Savings Approximately 75%, due to reduction of machining and scrap loss. Cast form requires machining of periphery and hub only.

Source: *Fairchild Engine & Airplane Corp., Stratos Div.*

37



Transmission Reverse Idler Fork

Part must have excellent wear and strength comparable to a mild steel forging in order to stand up under the strains imposed on automobile transmission parts. Good machinability necessary due to large finished areas, drilled, threaded holes.

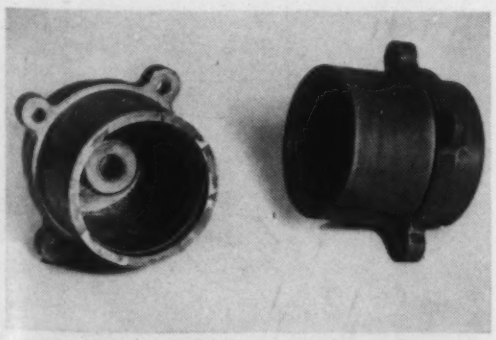
Old Bronze forging (left).

New Pearlitic malleable iron casting (right).

Savings Pearlitic malleable iron is less costly than bronze; casting eliminates several operations necessary in forging.

Source: *Chrysler Corp.*

38



Retainer

Holds spring assembly. Part is 2½ in. o.d., 2½ in. long with a 5/16-in. flange containing four ears. Must have smooth outer surface finish for assembly mating with other parts.

Old 195-T6 aluminum sand casting, with all surfaces turned and holes drilled.

New A380 aluminum die casting with holes cored. Undercut machined and center hole reamed.

Savings Approximately 50% due to reduction in machining, and amount of material used.

Source: *Fairchild Engine & Airplane Corp., Stratos Div.*

39

40

Waveguide Component

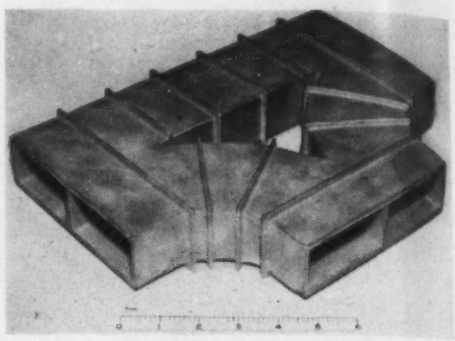
Interior surfaces must have a machine surface finish equivalent to drawn tubing. Dimensional tolerances must be held within ±0.003 in. for small sizes and ± 0.005 in. for larger sizes of waveguide.

Old Fabricated from aluminum, magnesium or bronze —sheet or bar stock. Individual pieces machined, formed, then assembled, brazed, finish machined and often required re-work to eliminate distortion.

New Precision sand castings in aluminum, magnesium or bronze. Foundry techniques make it unnecessary to machine. Tolerances obtained are as cast.

Savings Approximately 70% due to elimination of machining and assembly operations. Parts cast to size in one piece.

Source: *Sperry Gyroscope, Inc.; Div. of the Sperry Corp.*



41

"Y" Tube

Used for barometric flow check. Tube—4 in. long with 1/4-in. i.d., must be pressure tight with no obstruction or sharp bends to disrupt even air flow. Must be light weight for aircraft use.

Old Fabricated of 52S-O aluminum tubing by welding spliced tubing into "Y" shape.

New Precision investment cast in one piece in 356-T6 aluminum alloy.

Savings Approximately 50% due to elimination of intricate machining. Greatly improved functional operation of tubing.

Source: *Bell Aircraft Corp.*

42

Hinge Butt

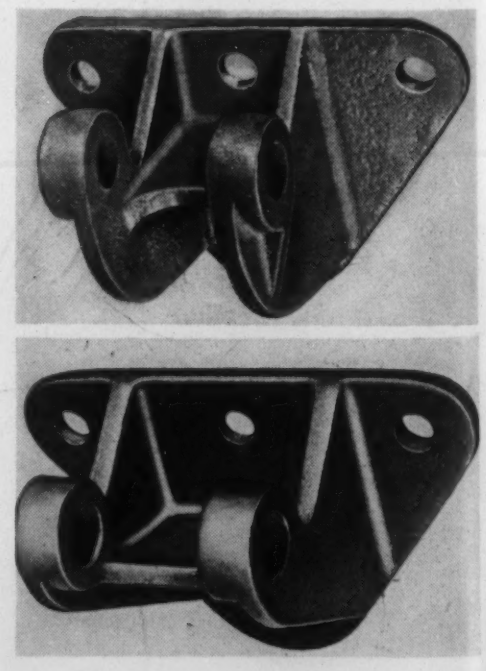
Part of hinge on railroad gondola cars. Approximately 6 7/8 x 6 1/4 in. Must have high strength and dimensional stability. Pin holes must be in line and parallel with base.

Old Cast 0.20-0.30 carbon steel. Bosses for pin holes on outside (top).

New Redesigned and cast in 0.20-0.30 carbon steel. Bosses on inside, and configuration altered to take stress direction into account (bottom).

Savings Approximately 16%, due to reduction in number of cores and material required. Old design put external and internal ribs in bending stress rather than compression or direct tension, as the redesigned casting did.

Source: *Steel Founders' Society of America; Superior Steel and Malleable Castings Co.*



Brazing Fixtures

Fixtures must withstand an operating cycle from room temperature to 2100 F to room temperature in 1 hr-10 min.

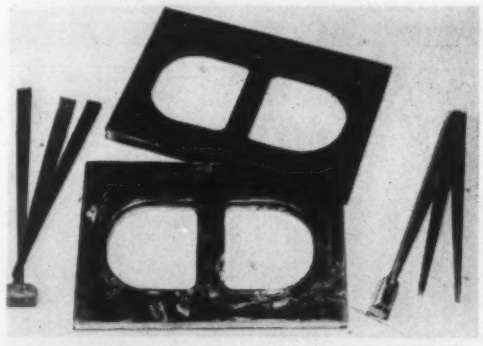
Old Heat resisting alloy.

New Bonded silicon carbide.

Savings The silicon carbide fixtures cost less, eliminated parts sticking and lasted five times as long as the metal fixtures.

Source: *Carborundum Co.*

43



Form Blocks

Used for rubber forming and as miscellaneous locators on jig fixtures.

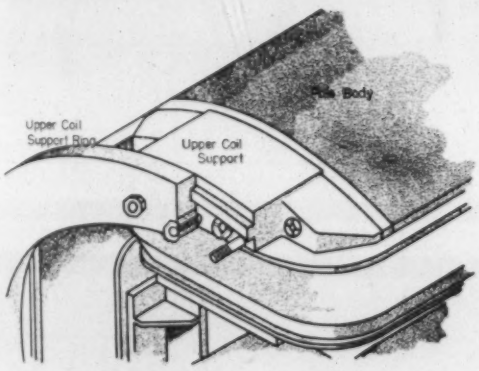
Old Machined steel plate.

New Aluminum cast plate machined to dimensions.

Savings Approximately 25-30%, due to greater ease of machining and final hand finishing. Also advantages gained in reduction in weight.

Source: *Republic Aviation Corp.*

44



Coil Support Ring

Upper coil support ring, 20 in. in dia, for special generator. Must be non-magnetic and have high strength.

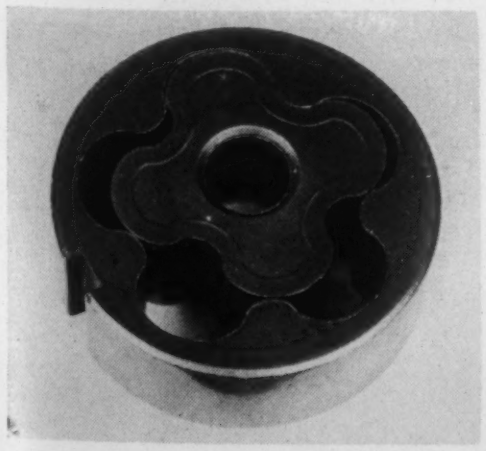
Old Forging of Discaloy (13.5 chromium, 26 nickel, 3 molybdenum, 1.7 titanium, 0.20% aluminum).

New Forging of 18:8 stainless steel.

Savings 75%, resulting from lower cost of material.

Source: *Westinghouse Electric Corp.*

45



Oil Pump Rotors

The parts must have good wear resistance to ensure a matching seal over the life of the automobile engine.

Old Cast iron and machined steel forging.

New Powdered iron, pressed and sintered. (Oilite)

Savings Tooling cost reduced, machining reduced, scrap eliminated.

Source: *Chrysler Corp.*

46

Armature Shaft

47

Used on electric motor driven welder, shaft is 3⅛ in. dia for 54 in., then extends 10½ in. at ⅛ in. dia. Smaller extension is seat for exciter armature. Must withstand 1800 rpm generator service.

Old Machined from SAE 1020 steel bar stock.

New Extension segment made of SAE 1020 steel bar stock of smaller dia, welded to main part of 1020 steel shaft, then machined to within tolerances.

Savings $4.60 per shaft, due to reduction in material used and 60% reduction in machining time.

Source: *Lincoln Electric Co.*

Transmission Shift Fork

48

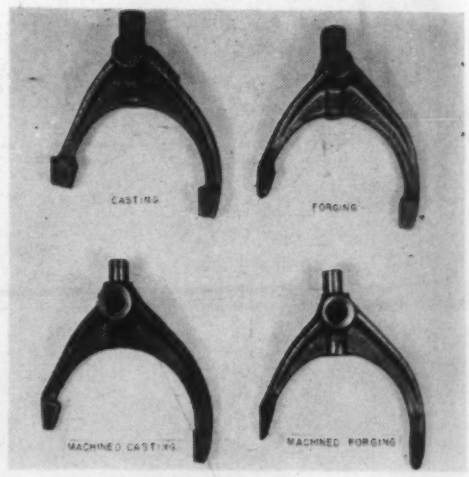
Part is 5-in. long by 4-in. wide at greatest dimension. The material must be tough, have good wear properties when hardened and have good machineability.

Old AISI C 1045 forging, induction hardened pads at ends of arms (right).

New Pearlitic malleable casting. Induction hardened pads (left).

Savings Part is a good shape for casting, which eliminates several forging operations. A slight improvement in machineability also was realized from material change.

Source: *Chrysler Corp.*



Door Panel Foundation Board

49

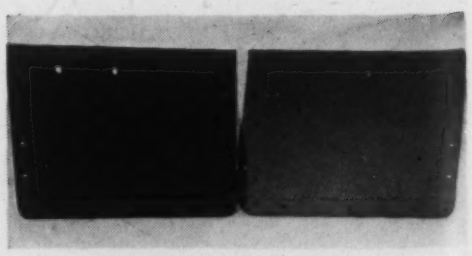
The foundation board backs up the upholstery in automobile doors. It must be dimensionally stable, waterproof, reasonably impact resistant and strong enough to be held by metal pins without tearing.

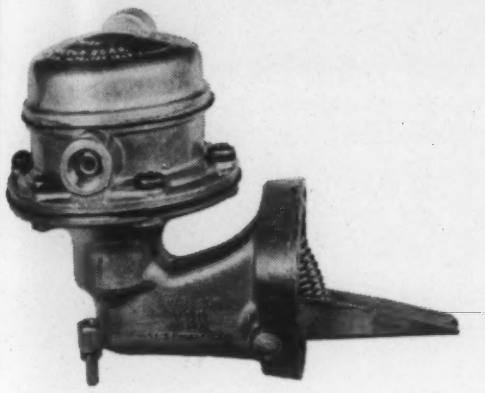
Old Asphalt impregnated fiber board (right).

New Water repellent kraft corrugated box-board (left).

Savings Part is a good shape for casting, which elimiservice. Handling in assembly is simplified since the new material is lighter, does not stain workers' hands or door trim.

Source: *Chrysler Corp.*





Fuel Pump Shell

Cast cover, valve housing and body of automobile fuel pump must seal gasoline under pressure. The flanges must have good creep resistance to maintain pressure on gaskets and must be strong enough to resist breaking when bolted to engine block. Average wall thickness is 1/8 in.

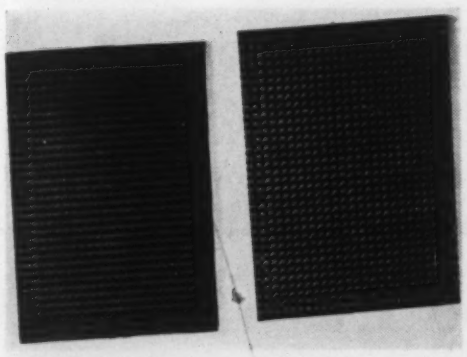
Old Zinc die casting.

New Aluminum die casting.

Savings Flange breakage and deformation eliminated, aluminum for casting less expensive per unit volume. Material cost savings range around 30%, at the average price of zinc.

Source: *Chrysler Corp.*

50



Computer Plugboard Panels

Panels are about 9 x 7 in. in size and contain 816 holes 0.156 in. in dia about 0.30 in. apart. Holes must be accurately located. Surface must be free from marks and scratches. Panels must be flat within 1/32 in.

Old Laminated phenolic ("LE") sheets, milled and drilled (left).

New Molded phenolic (BM120) (right).

Savings 50%, due to elimination of expensive milling of slots and drilling 816 holes.

Source: *Remington Rand, Inc.*

51

Drilling Auger

Used for drilling in various types of earth formations. Length 7 in., dia 3⅝ in. Must have rigidity, abrasion resistance and be reasonably ductile. Must be weldable for hard facing.

Old Body made of mild steel to which blades of 4140 steel were welded (top).

New Cast in one piece of chromium-manganese-molybdenum steel (bottom).

Savings Approximately 45%, due to elimination of assembly operations and reduction of machining. Also, part had less distortion, better rigidity and improved appearance.

Source: *Steel Founders' Society of America; Pacific Steel Casting Co.*

52

53

Worm Gear

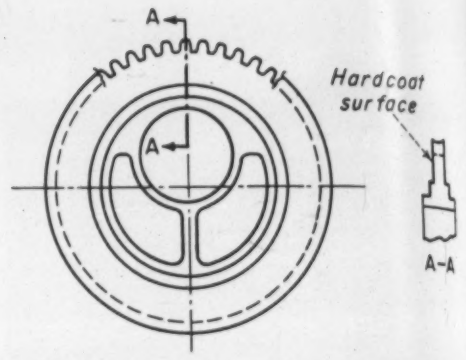
A 3.880-in. o.d. gear used on an aircraft gun mount. Must be corrosion-resistant and operate without excessive wear.

Old Machined from aluminum bronze bar stock.

New Machined from 75S-T6 aluminum alloy bar stock. Gear teeth surfaces electrolytically oxidized by Martin hard coat process as shown.

Savings Approximately 70%, resulting from reduction in cost of material. Change also desirable because of the weight reduction: about 4 lb per gear or 68%.

Source: *The Glenn L. Martin Co.*



54

Freezer Cabinet Frame

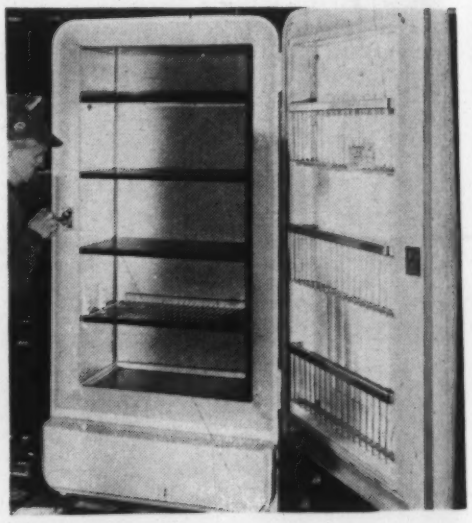
Breaker frame used on upright freezer cabinet. Largest of various sizes measures about 36 x 57 in., has a projected area of about 800 sq in., and weighs about 3 lb. Must have glossy surface, provide good thermal insulation, provide for thermal expansion without damage, and withstand abrasion and extreme temperature and humidity conditions.

Old Four straight extrusions of ethyl cellulose, with joints covered by molded corner pieces of polystyrene screwed in place.

New One-piece molded frame of high-impact polystyrene.

Savings Approximately 50%, resulting from reduction in cost of material and simplified assembly. Change also desirable because of the low moisture absorption of polystyrene and the improved appearance of the new design.

Source: *General American Transportation Corp., Plastics Division; Amana Refrigeration, Inc.*



55

Cover For Fuel Gage Inspection Hole

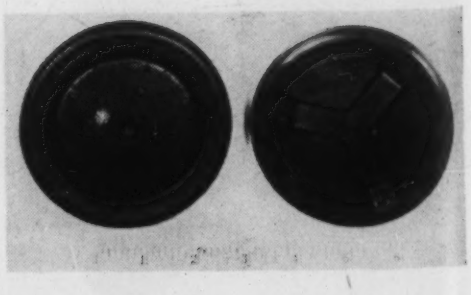
The 4-in. cover is molded with retaining lugs so that it snaps in place in a 3¼ in.-hole in the floor pan of an automobile. It must be stiff enough to bridge hole and stay in place during vibration and shock.

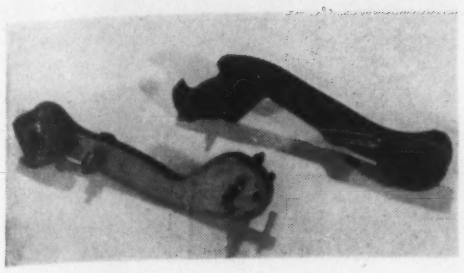
Old 70 durometer hardness rubber compound containing a metal disk insert (left).

New 90 durometer hardness rubber without insert (right).

Savings Removal of insert simplified production, eliminated stamping and handling metal disk.

Source: *Chrysler Corp.*





Clock Part

Alarm hammer for alarm clock is specially curved pivoted piece 1-1/4 in. long, 3/16 in. wide and 1/8 in. thick. Close tolerances to give precise balance, high corrosion and impact resistance required.

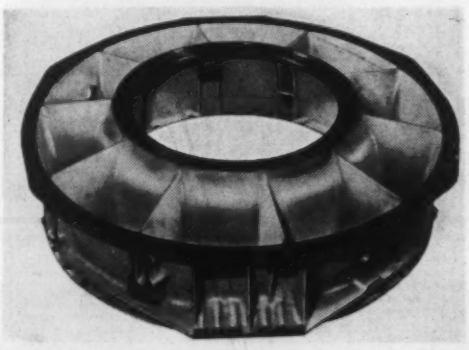
Old Made up of six components. Blanked from sheet brass, holes drilled and tapped, and components assembled (left).

New Total of only 3 components: oil impregnated iron powder part, a staff and a stop pin.

Savings About 30%. Machining operations and scrap eliminated plus cutting of inspection costs. New part had better wear characteristics because of oil impregnation.

Source: *Metal Powder Assoc.; Lux Clock Mfg. Co.*

56



Turbo-Jet Engine Support

This support for 11-ft long engine consists of an inner ring attached to an outer ring by a series of struts. Center ring must withstand 7200 lb thrust.

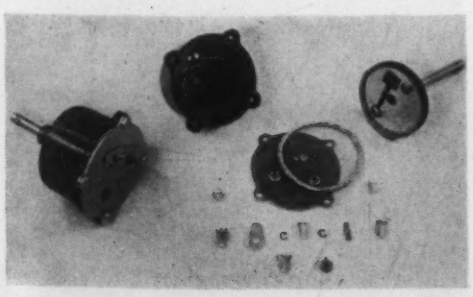
Old Aluminum alloy forging. Starting with doughnut shape, the struts, rings and other details were hogged out.

New Cast Ductile (nodular) iron inner and outer rings machined and joined together with stainless steel struts welded to the rings.

Savings At least 80%. Saving achieved through elimination of hogging operations which took 1200 hr.

Source: *International Nickel Co., Inc.*

57



Air Cylinder Assembly

Cylinder is approximately 2 in. in dia by 2 in. long. 3/4-in. bearing for piston shaft. Assembly must have constant compression characteristics through normal atmospheric changes and normal operating life, low friction of operating parts, and parts must be easily assembled.

Old Aluminum die cast cylinder, machined to close tolerances and fabricated steel piston.

New Mineral filled phenolic cylinder molded complete. Mineral filled phenolic piston molded on shaft complete.

Savings 60%, because of elimination of selective assembly and expensive machining.

Source: *International Business Machines Corp.*

58

59

Governor Drive Gear

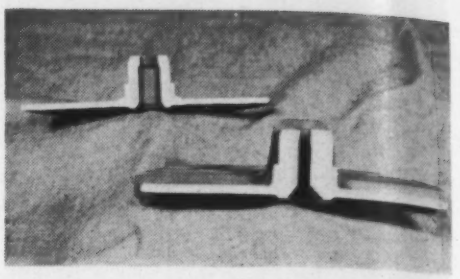
Approximately 6¾ in. dia. with 1⅛ in. o.d. hub. Gear teeth must be hard and abrasion resistant.

Old Machined from SAE 8617 steel forging, carburized and die quenched (bottom).

New Two part weldment. Face stamped from SAE 1035 steel sheet stock and induction hardened. Hub machined from SAE 1035 bar stock and welded to face (top).

Savings Approximately 40%, due to ability to stamp and heat treat flat faces of gear in lots of 25 at a time; also reduction in machining time.

Source: *General Motors Corp., Allison Div.*



60

Engine Hoist Fitting

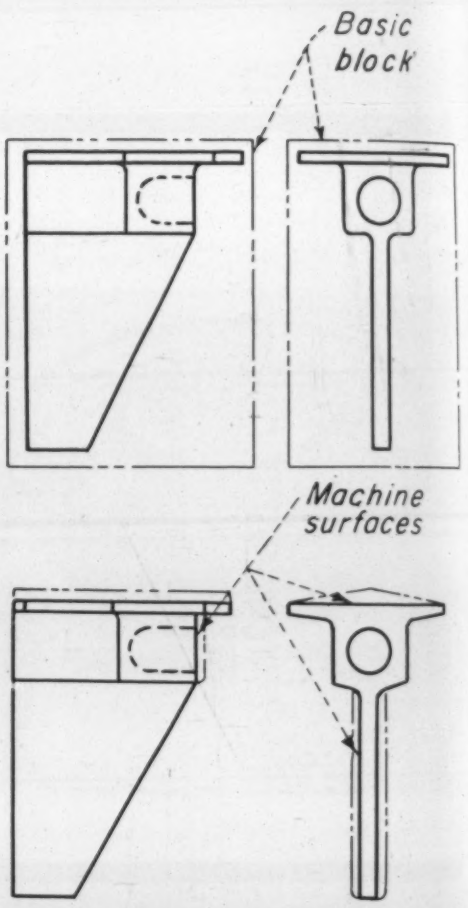
A T-shaped fitting 9¼ in. high which is installed in an aircraft upper wing surface to support an engine hoist tripod. Must be able to withstand high compressive and bending loads.

Old Machined from 75S-T6 aluminum alloy bar stock, 10x4½x6 in. (top).

New Same material forged in closed dies and machined as shown (bottom).

Savings Approximately 60% based on 400 pieces. Savings attributable primarily to reduced machining costs. Scrap loss also reduced 2.43 lb per fitting.

Source: *The Glenn L. Martin Co.*



61

Ring-Plate Valves

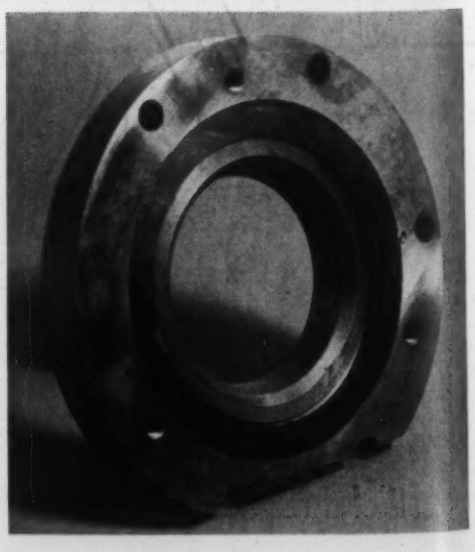
Used on freon compressors. Must have high hardness, yield and tensile strength.

Old Carbon steel strip, blanked, and heat treated to desired hardness.

New Type 17-7 PH (precipitation-hardening) stainless steel strip, 0.040-in. thick, purchased in cold-worked condition, blanked and heat treated.

Savings Cost reduction due to the need for only one low-temperature heat treatment, since cold-working has already imparted some hardness to material. Yield and tensile strengths also very high.

Source: *Armco Steel Corp.*



Light Fixture Disk

This disk is used in fluorescent starter base to seal and insulate starters. Disk must be flat for automatic assembly, have good electrical insulation properties and little moisture absorption.

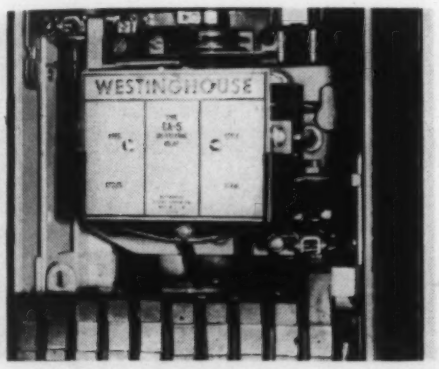
Old Phenolic laminate.

New Cellulosic-base resin-bonded fiber board.

Savings About 40%, because of lower raw material cost.

Source: *Rogers Corp.*

62



Instrument Name Plates

Name plates for instruments and relays must be adaptable to photoengraving and be corrosion resistant (under protected conditions) in order to remain legible.

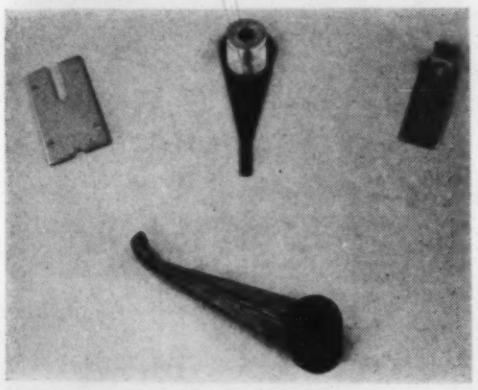
Old Nickel silver sheet.

New Aluminum alloy 3S sheet.

Savings 34.4% ($6140 per year), resulting from reduction in cost of material.

Source: *Westinghouse Electric Corp.*

63



Card Pusher Finger

Part used on card stacking mechanism of a card punch machine. Must have smooth surface finish. Must stack cards without marring or breaking edge.

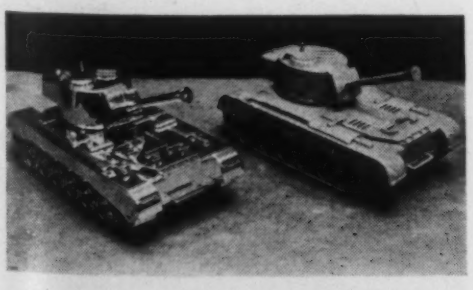
Old Machined and formed steel parts (top).

New Anodized aluminum die casting (bottom).

Savings 60%, because of reduction in number of parts and assembly operations.

Source: *International Business Machines Corp*

64



Toy Tank

Must have eye appeal.

Old Molded of virgin polystyrene (right).

New Molded of scrap polystyrene or cellulose acetate and vacuum metallized with aluminum (left).

Savings Approximately 50%, resulting from reduction in cost of plastic from 35 cents per lb to 5-10 cents per lb. Change also desirable because of metallic appearance achieved.

Source: *F. J. Stokes Machine Co.; Ideal Toy Corp.*

65

66

Master Contour Tool

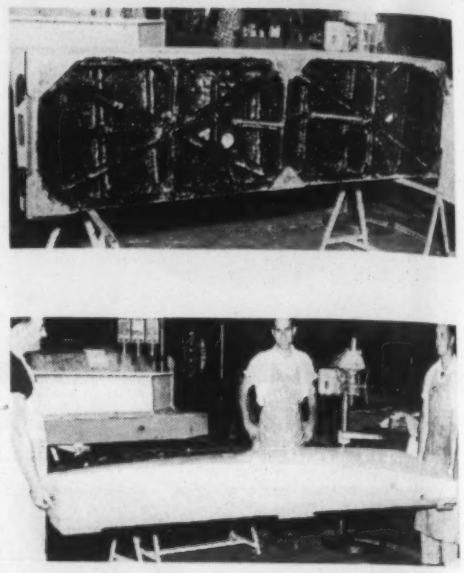
Master compound contour tool for an area of F84F wing. Approximately 3 x 8 feet. Must have high dimensional stability, accurate contour configurations, and locations for 3 critical holes.

Old Kirksite casting, ground to contour and mounted on specially constructed dolly.

New Epoxy resin-glass cloth laminate, reinforced with paper based phenolic tubing. Aluminum blocks molded-in to locate 3 critical holes (see photograph).

Savings Approximately 80%, due to reduction in construction time. Increased cost of plastic and glass fiber offset by decreased amount of material used. Weight of tool reduced from 3100 lb for Kirksite (plus 1000 lb for special dolly) to 240 lb for plastic tool. The latter sagged less than 0.001 in. in the center when suspended from ends, while Kirksite tool sagged over 0.25 in., thus requiring special dolly.

Source: *Republic Aviation Corp.*



67

Shock Absorber Piston

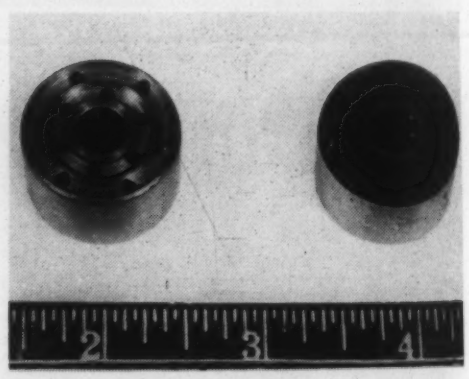
The part must have good compressive strength and excellent wear resistance to stand up under the stress and wear involved in damping automobile shocks.

Old Cast iron and brass (left).

New Powdered iron—sintered (right).

Savings Reduced material cost by eliminating brass, reduced machining operations, eliminated scrap loss.

Source: *Chrysler Corp.*



68

Connecting Rod

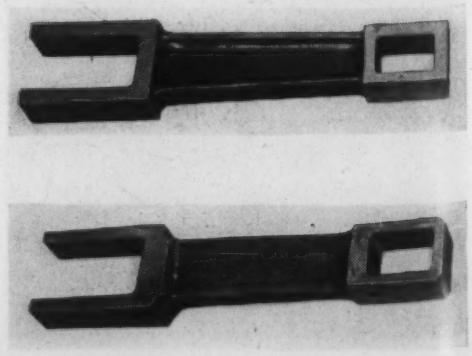
Length, 32 in.; max width, 7 in.; thickness 3½ in., with square bearing end. Must have high tensile and compressive strength with minimum weight, good machinability and shock resistance.

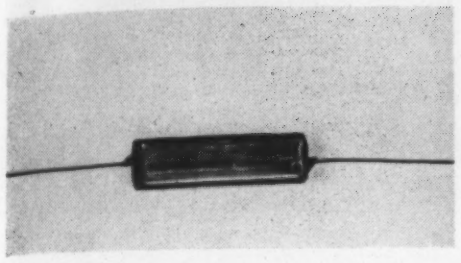
Old Bull-dozed forging of SAE 1045 steel (bottom).

New Cast steel leaving allowance for finishing only (top).

Savings 46%, due to reduction in machining and material used. Weight reduced from 89 to 70½ lb.

Source: *Steel Founders' Society of America; Malleable Iron Fittings Co.*





Capacitor Insulation

Dielectric winding for electrical capacitors used to prevent formation of arcs in relay contacts. Must be thin and have: chemical stability; resistance to moisture penetration and decomposition by hydrolysis; good dielectric strength; good mechanical strength; high temperature stability; and low direct current conductivity.

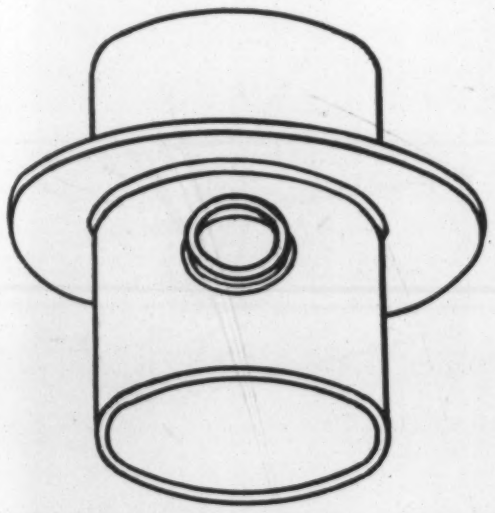
Old Mineral-oil-impregnated paper protected with lacquer.

New Heat-sealed "Mylar" (polyethylene terephthalate), a strong, transparent polyester film.

Savings Figures unavailable, but savings claimed as a result of elimination of protective lacquer coating. Change also desirable because of increased moisture resistance, greater heat tolerance, better material quality control, and reduction in capacitor size.

Source: *Bell Telephone Laboratories, Inc.*

69



Ventilating Outlet

Tube inserted through disk forms heating and ventilating outlet for aircraft cockpit. Joint must be airtight.

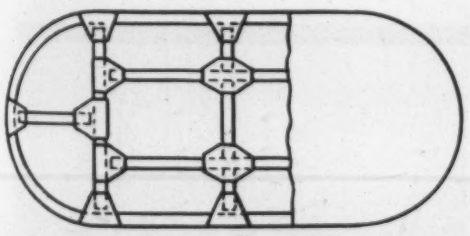
Old Both parts made from 61S aluminum alloy sheet and assembled by heli-arc fusion welding.

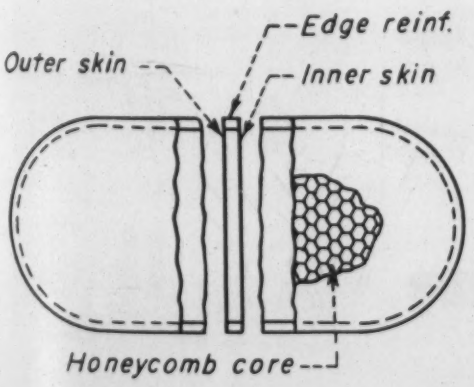
New Same materials assembled by dip brazing instead of welding.

Savings 43%, resulting from elimination of a hand straightening operation made necessary by metal distortion occurring during welding.

Source: *The Glenn L. Martin Co.*

70





Aircraft Bulkhead Door

Measures 5 ft high and 32 in. wide. Must be watertight under 10 psi load and must be fairly rigid.

Old Built up with 0.025-in. 24ST aluminum alloy skin, 0.040-in. 24ST frame, and numerous aluminum alloy stiffeners and gussets. Total of 39 details assembled with rivets and spotwelds (top).

New Aluminum honeycomb core of 0.001-in. foil and ⅛-in. cell sandwiched between two 0.016-in. 24ST aluminum alloy skins. Total of three details assembled by metal bonding with FM-47 adhesive (bottom).

Savings Approximately 41% based on 200 assemblies. Savings attributable to reduced number of parts, less tooling and less fabrication time needed. Change also desirable because of the weight reduction: 3.4 lb per door or 15%.

Source: *The Glenn L. Martin Co.*

71

72

Exhaust Muffler

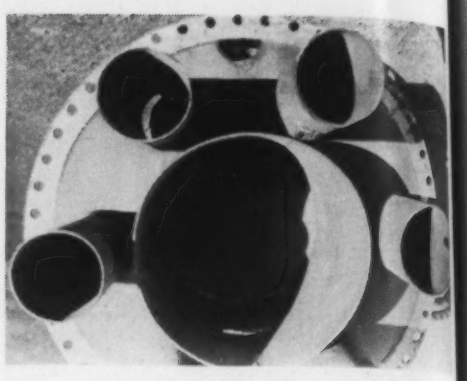
Diesel engine wet type exhaust muffler, 2 ft, 5 in. dia by 96 in. long. Part must withstand high temperatures and resist corrosive action of sea water and exhaust gas.

Old Fabricated from heavy mild steel sections by welding; galvanized.

New Fabricated from thinner mild steel sections by welding; ceramic coated.

Savings 50% in weight resulting in cost saving, and 50% or more in maintenance costs because of less frequent replacements.

Source: *United States Navy*



73

Instrument Cover

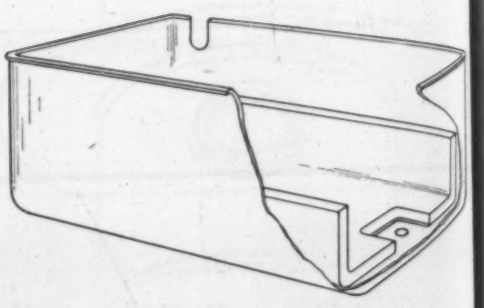
Part is 16 in. by 26 in. by 9¼ in. with wrinkle enamel finish. Must have dimensional stability, sound insulation and ability to withstand rough handling.

Old Three part assembly. Two die-cast aluminum end pieces with aluminum sheet wrap-around for center section. Three units riveted together, joints filled and assembly enameled.

New Glass reinforced plastic one-piece molding.

Savings Approximately 35 to 50% attributed to lower assembly time, and reduced shipping costs because of lighter weight.

Source: *Winner Manufacturing Co., Inc.*



74

Bullet Cup

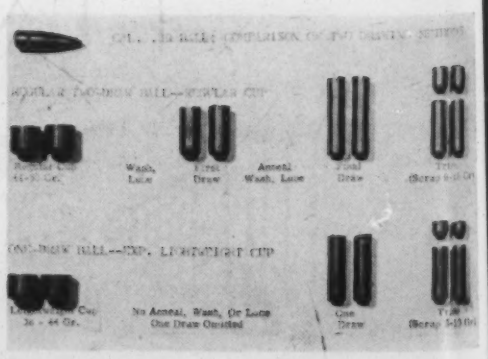
Caliber 0.30 ball bullet jacket cup.

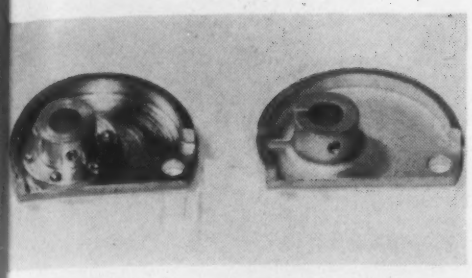
Old Regular cup, brass, (44-50 Gr.) wash, lubricate, draw, anneal, wash, lubricate, draw, trim (scrap 9-16 Gr.) (top row).

New Lightweight cup, brass, (38-44 Gr.) draw, trim (scrap 3-10 Gr.) (bottom row).

Savings $12,635 per 10,000,000 rounds (estimated $5,635 by elimination of one drawing operation together with annealing, washing, etc. and $7,000 by reduction in material).

Source: *United States Army*





Valve Cam

Segment approximately 1¾-in. dia with hub 9/16-in. o.d. and 0.312 i.d., splined Cam surface requires 10 rms finish and hardness of Rc 54. Hub must be under Rc 28-32 for broaching.

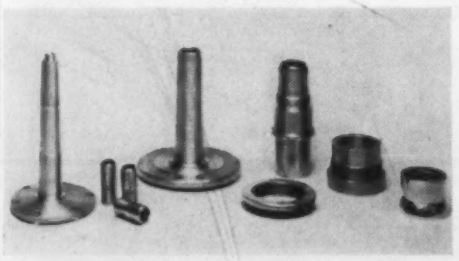
Old Two piece assembly. Cam segment of 4140 steel turned from bar stock and hardened to Rc 50. Hub of ½ hard brass turned from bar stock and broached. Two pieces then riveted.

New One piece precision investment casting in 4140 steel, all holes cored to size. Outer periphery ground and hub i.d. broached and tapped for set screw. Cam area surface hardened to Rc 50.

Savings Approximately 86% due to reduction of machining and elimination of assembly operation.

Source: *Fairchild Engine & Airplane Corp., Stratos Div.*

75



Instrument Parts and Bearings

Bronze bearings and parts for surveying instruments must be machined to extremely close tolerances.

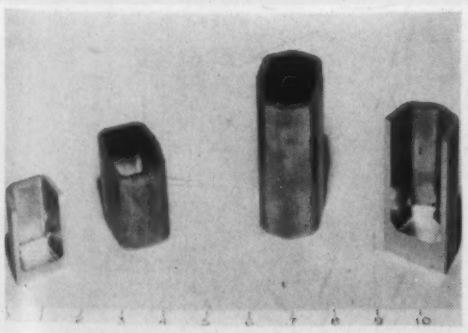
Old Machined from sand castings.

New Machined from continuous cast bronze on fully automatic machines.

Savings Substantially lower cost production because of minimizing rejections due to porosity, blow-holes and other internal defects.

Source: *W. & L. E. Gurley; American Smelting & Refining Co.*

76



Wing Tip Fuel Pod Attachments

Chief requirements of the attachments aft (left) and forward (right) are high strength and low cost.

Old Parts had previously been machined from solid billets of aluminum or as aluminum forgings.

New Impact extruding of 14S-T6 now used to produce can sections which are later cut in half to make two parts.

Savings Cost of parts has been approximately halved over the most expensive method of production (machining) and reduced appreciably below forging costs. Comparative costs of three methods are given for the two parts in quantities of 180 pieces each.

	Aft Section	Forward Section
Machined	$5.59 each	$9.73 each
Forging	4.07 each	6.54 each
Impact Extrusion ...	2.01 each	5.89 each

Source: *Hunter Douglas Corp.; Northrop Aircraft, Inc.*

77

78

Machine Base

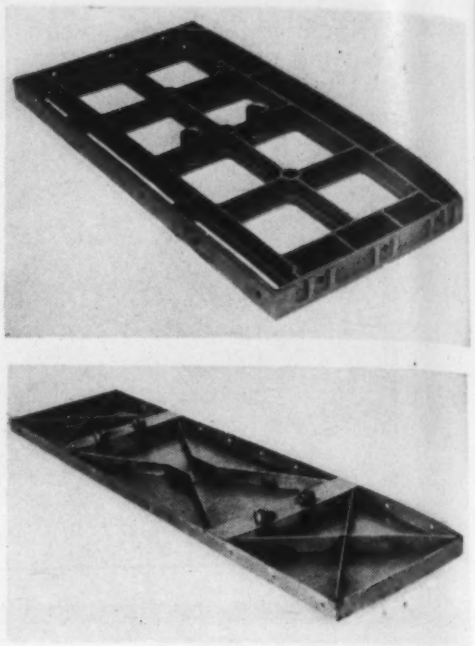
"Bed" for textile uptwister machine. All four sides of base must be square and straight. Holes for vertical suspension rods must be faced, and distance between holes must be held to tolerances of ± 0.002 in.

Old Gray iron casting machined to final dimensions (top).

New Hot rolled mild steel weldment (bottom).

Savings $11.93 per base. Partly due to reduction in machining operations, material used, and tooling cost. Also, with castings, length of base sections was determined by most efficient casting techniques; therefore old machine required 16 "beds" per machine. With weldment, longer "beds" are feasible, reducing number per machine to 8. Design flexibility allows meeting of varying customer specifications.

Source: *James F. Lincoln Arc Welding Foundation*



79

Cutting Machine Rail

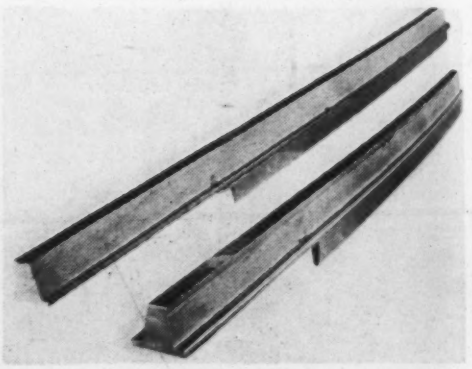
Twelve foot track for oxyacetylene shape-cutting machine. Must have dimensional stability and rigidity to insure cutting accuracy of machine.

Old Cast iron rail and fabricated steel base assembly (two parts).

New Gray iron casting (one piece).

Savings Elimination of two machining operations and one assembly operation. Cutting accuracy held to 0.015 in. over length of track.

Source: *Gray Iron Founders' Society, Inc.*



80

Automobile Oil-Pump Gears

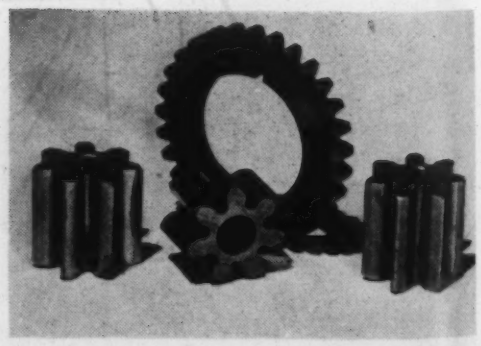
The three small gears are lubricating oil-pump gears, the larger is an automatic transmission oil-pump driving gear. The smaller gears must have tooth strength of 2000 lb, tolerance must be within 0.001 in. o.d., 0.0005 in. i.d. and must be concentric to 0.001 in., total indicator reading. Transmission oil pump gear must meet approximately the same tolerances. All must have good wear resistance.

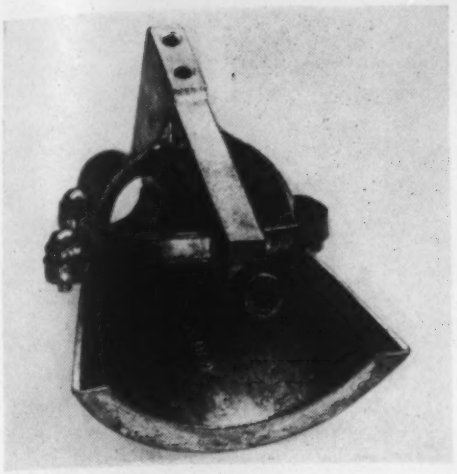
Old Machined from carbon steel bar stock, case hardened.

New Sintered iron powder.

Savings Lower tooling cost, machining eliminated, no scrap loss, case hardening eliminated.

Source: *Ford Motor Co.*





Water Inlet

Funnel assembly designed to admit water to "Laundromat" automatic clothes washer but prevent back-siphonage of wash water into water supply line. Must withstand mild impact and resist deterioration in a humid, alkaline environment.

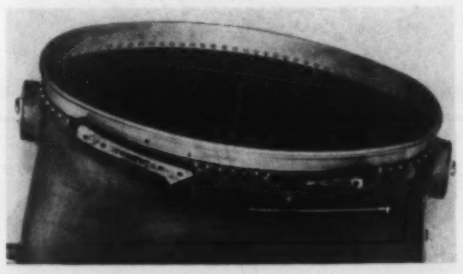
Old Two zinc die castings assembled with screws.

New Two parts molded of "agitator grade" phenolic plastic and assembled with screws.

Savings Approximately 48%, resulting from reduction in cost of material. Change also desirable because of the elimination of a corrosion problem with the zinc.

Source: *Westinghouse Electric Corp.*

81



Bearing Support Flange

Inlet flange has shape of elliptical ring with 14-in. minor axis and 27-in. major axis. Width 1¾ in., thickness ⅝ in. Must have moderate strength, good surface finish, and close dimensional tolerances for mating fits.

Old Machined from elliptical casting of aluminum alloy 356-T6.

New Extruded section of aluminum alloy 61S-T6 contour formed to shape.

Savings About 65%, resulting from elimination of intricate machining operations.

Source: *Westinghouse Electric Corp.*

82

Pump Guide Vanes

Stationary guide vane assembly for circulating pump must be corrosion-resistant and resist erosion by high-velocity water containing some suspended solids. Shape requires alloy having good castability and fluidity.

Old Bronze (88-90 copper, 8-10% tin) casting.

New Gray iron (ASTM Class No. 30) casting.

Savings About 65%, resulting from reduction in cost of material.

Source: *Westinghouse Electric Corp.*

83

84 Electron Tube Anodes

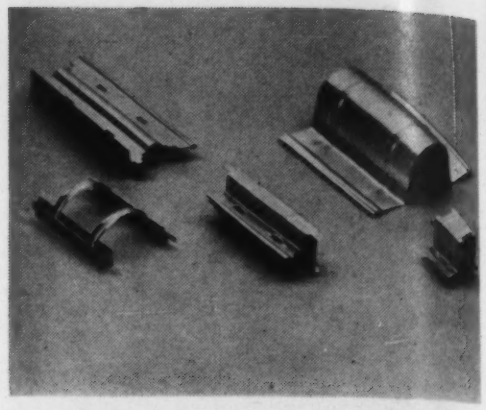
Must have black surface for maximum radiation absorption.

Old Formed from carbonized nickel.

New Formed from low carbon steel double-clad with aluminum that is blackened during tube manufacture.

Savings Reduction of about 50% in cost of material. Change also desirable because of relatively critical nature of nickel supply.

Source: *General Plate Division of Metals & Controls Corp.*



85 Card Register Block

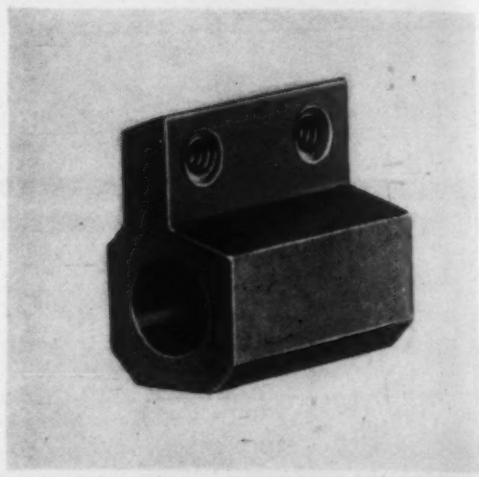
A business machine part requiring close dimensional tolerances, sharp contours and concentricity of bore.

Old Machined from C1010 steel.

New Iron powder, pressed and sintered. Composition: 98 iron (min), 0.1 carbon, 0.06 max combined carbon, 2% max impurities. Holes tapped after sintering.

Savings Approximately 82%, resulting from elimination of most machining operations.

Source: *F. J. Stokes Machine Co.; International Business Machines, Inc.*



86 Insulating Washer

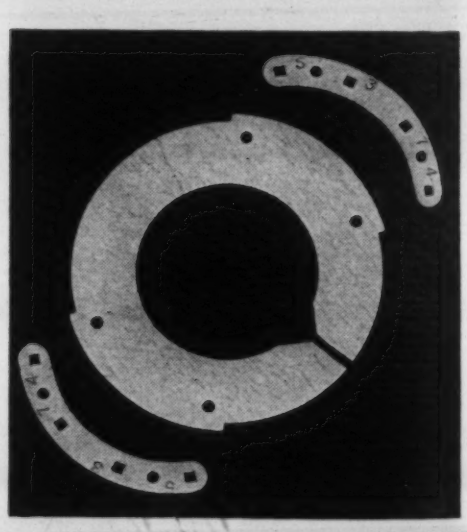
Electric range insulating washer is ¾ o.d. x 0.201 i.d. and 3/16 in. thick. Must have high electrical insulation properties, good strength and flatness.

Old Machined phenolic.

New Cellulosic-base resin-bonded fiber board.

Savings About 20% because of lower raw material cost.

Source: *Rogers Corp.*



87 Surgical Instrument Lug

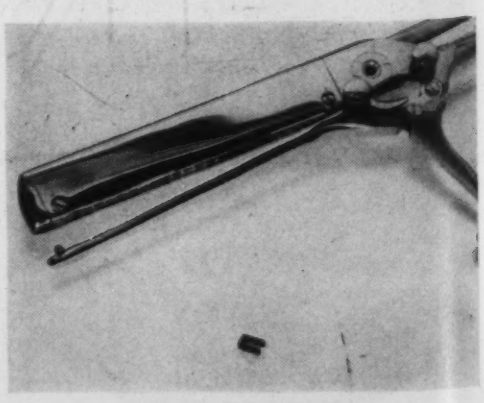
Twenty-three of these tiny lugs are used in surgeons' suturing apparatus. Must be corrosion resistant, made to close tolerance, and have smooth sliding bit.

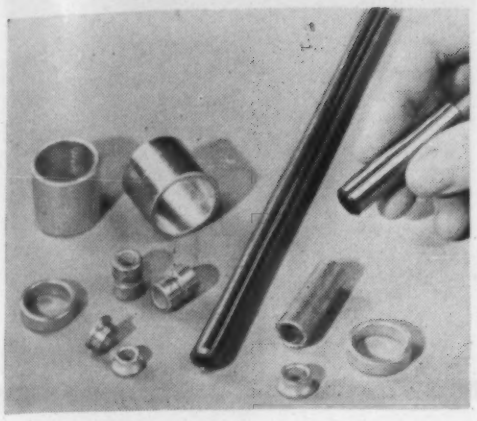
Old Machined from bar stock.

New Precision cast from Type 302 stainless steel. Given slight touch up grinding.

Savings Cost cut from 55¢ to 22¢ apiece—a savings of 60%.

Source: *International Nickel Co., Inc.*





Aircraft Bushings

Used mainly for bearings on aircraft control rods. Usual bore size range is from 0.190 to 0.375 in. Tensile strength requirements range from 125,000 to 145,000 psi. Dimensional tolerances: ±0.001 in. on i.d. and ±0.00025 in. on o.d. Maximum surface roughness: 100 micro-in. Must withstand severe vibration and must therefore be free from cracks, fissures and other defects.

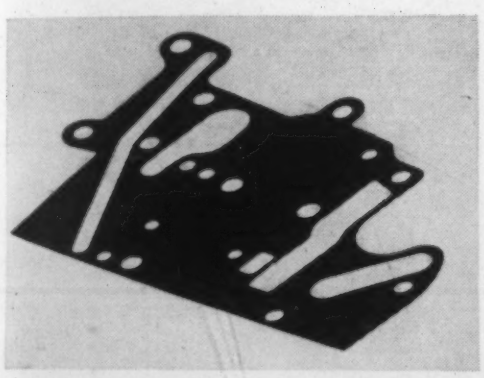
Old 4130 alloy steel bar stock, drilled and reamed to form inside diameter.

New Cold drawn 4130 steel tubing of the specified inside diameter size.

Savings 15 to 20%, resulting from (a) elimination of machining operations, and (b) reduction of the reject rate on finished parts from 30-35% to virtually zero.

Source: *Superior Tube Co.; Aircraft Products Co.*

88



Gasket

Gasket in various sizes is used in automatic torque convertor. Must have clean fabricated edges and smooth surfaces and withstand high pressures.

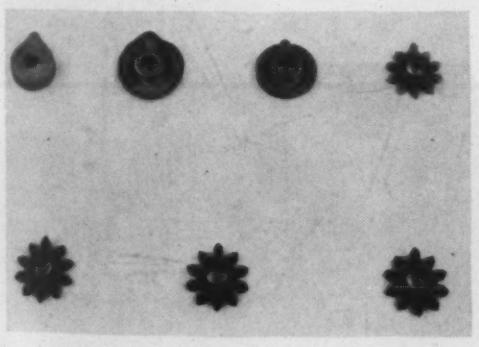
Old Hard fiber with rubber overlay.

New Cellulose beater treated with Hycar rubber.

Savings 25% saved because of lower manufacturing costs.

Source: *Rogers Corp.*

89



Reel Counterwheel

This part for a business machine has 10 teeth and a 0.10-in. hub. One tooth extends the length of the hub. Outside diameter is 0.750 in. Part must have good impact and wear resistance and be easy to fabricate since quantities required are high.

Old Solid steel. Operations to produce were: blanking. coining to obtain hub and high tooth, boring, teeth hobbed, length ground to 0.0005 in. (see top row in photo). Part carburized 0.006 in. to 0.008 in. and hardened, then flash chrome plated. 100% inspection.

New Copper-infiltrated iron sized to gear contour; case-hardened 0.006 to 0.008 in.; black oxide treated for identification; parts ground to 0.0005 in. (see bottom row)

Savings 75%. Expensive machining operation and 100% inspection eliminated. Closer material control required now, but less dimensional control.

Source: *International Business Machines Corp.*

90

91

Fuse Component

The ring-shaped artillery fuse component must be corrosion resistant and must withstand the heavy shock of firing and initial impact.

Old Plated steel part machined from bar stock required 8 separate operations of machining, milling, and finishing.

New Plated powdered iron sintering.

Savings 62%. Powdered iron sintering reduced operations to three, eliminated large scrap loss.

Source: *Lionel Corp.*

92

Circuit Breaker Contact

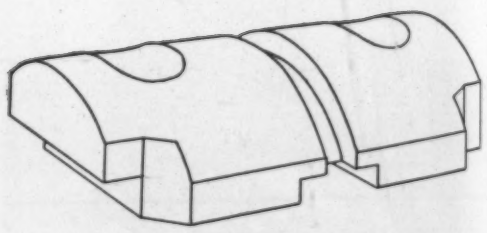
Must be sound throughout and have high electrical conductivity, high strength and close dimensional tolerances. Overall dimensions: 3⅞ x 2⅛ x 15/16 in.

Old Machined from octagonal, forged bar of Cupaloy (99.4 copper, 0.5 chromium, 0.1% silver) which had been previously cast and heat treated.

New Shell mold cast of Cupaloy and machined as shown.

Savings 45%. Of this cost saving, one-third is attributable to reduced material cost, and two-thirds to elimination of several machining operations (machining to outside shape, drilling two holes, and machining 5/16-in. outside slot).

Source: *Westinghouse Electric Corp.*



93

Cable Sheath

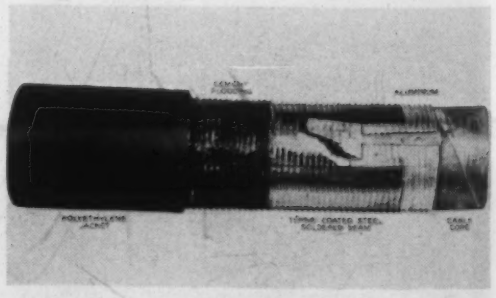
Used to protect core of exchange cable. Must keep out moisture, be adaptable to easy splice covering, and utilize readily available materials.

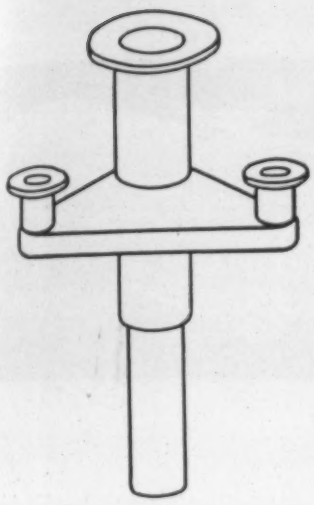
Old Lead alloy extruded over the core.

New Stalpeth, a steel-aluminum-polyethylene assembly. The core is wrapped first with corrugated aluminum strip, then with terne-plated corrugated steel strip that meshes with the aluminum. A thin flat ribbon of solder is inserted in the overlap of the corrugated steel and the joint is sealed by induction heating. Steel surface is then flooded with rubber cement and polyethylene is extruded on.

Savings Figures unavailable, but savings claimed as a result of reduction in cost of material. Developed to improve performance of Alpeth (same construction without corrugated steel jacket and without metal joining) which, in turn, was developed at a time when lead was in short supply.

Source: *Bell Telephone Laboratories, Inc.*





Bollard

A 2-ft high mooring post located inside forward entrance hatch of seaplane. Must be corrosion-resistant and able to withstand medium-to-high shock loads.

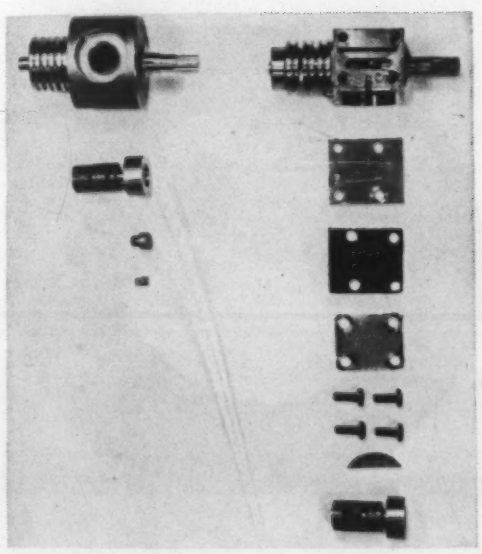
Old 4130 steel tubing and sheet assembled by welding and nickel-plated.

New 17-7PH stainless steel tubing welded to a sand-cast head of the same material.

Savings Approximately 72%, resulting from (a) elimination of a straightening operation made necessary by metal distortion occurring during welding and heat treatment, and (b) elimination of the plating process which had required excessive rework because of unsatisfactory adherence.

Source: *The Glenn L. Martin Co.*

94



Hydraulic Governor

Machined cylinder with splined hub. Hole in cylinder for actuator weight must have smooth inner surface. Cylinder must be concentric on hub.

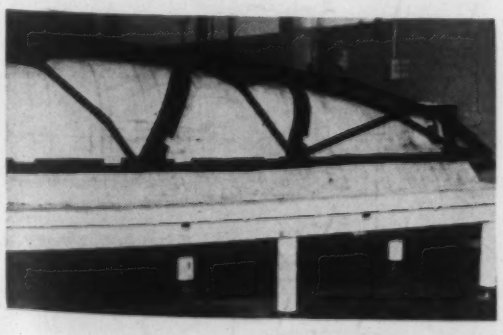
Old Machined from SAE 8640 steel forging and built up into assembly (right).

New Machined from SAE 8640 steel bar stock, and redesigned to reduce number of parts in assembly (left).

Savings $5.75 per governor, due to reduction in 1) material used, 2) machining, and 3) assembly operations.

Source: *General Motors Corp., Allison Div.*

95



Canopy Checking Fixture

Used to coordinate contours on F84F canopy and turtle-deck sections. Must have high dimensional stability and accurate contour configurations.

Old All welded construction of steel tubing and formed steel plate.

New Epoxy resin-glass cloth laminate, molded to contour and reinforced with paper based phenolic tubing bonded together with asbestos filled epoxy resin paste.

Savings Approximately 80%, due to reduced construction time. Increased cost of plastic offset by decreased amount of material used. Weight of tool reduced from 375 lb for steel to 75 lb for plastic.

Source: *Republic Aviation Corp.*

96

97

Stretch Form Block

Sizes range from 2 ft square to 5 x 10 ft. Used for stretch-wrap forming of aluminum skins, 0.032- to 0.084-in. thick.

Old Kirksite casting ground to contour.

New Epoxy resin-glass cloth laminated shell, filled with foamed phenolic resin, mounted on reinforced boiler plate base.

Savings Approximately 50%. Molding plastic tool to shape eliminates all hand finishing or grinding. Reduces skilled labor by ⅔. Plastic tool weighs 1/6 as much as Kirksite.

Source: *Republic Aviation Corp.*

98

Valve Disk Sleeve

Small part acts as guide for valve disk in air-release mechanism of petroleum meter. Measures 2¾ in. dia, ⅜ in. thick. Must be corrosion-resistant and meet tolerances of ±0.001 in. on two diameters.

Old Machined from plain brass rod stock.

New Brass (80% copper, 20% zinc) powder pressed and sintered.

Savings About 67%, resulting from elimination of machining operations. Zinc die casting with protective coating offered equal savings but was unsatisfactory in service.

Source: *F. J. Stokes Machine Co.; Neptune Meter Co.*

99

Torque Box Plate

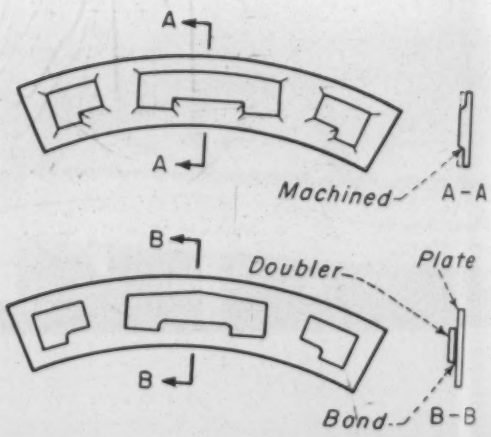
Arched plate 92 in. long and 4 in. wide with built-up sections at areas of load concentration. Must be able to withstand high loads.

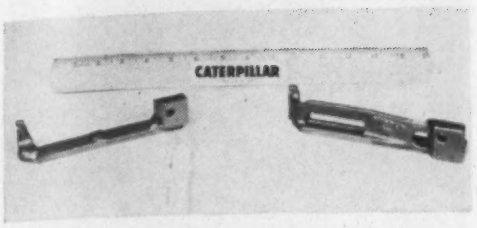
Old Machined from ¼-in. 24ST aluminum alloy plate (top).

New Web blanked from 24ST aluminum alloy sheet. Built-up sections formed by bonding on three 24ST stampings with FM-47 adhesive (bottom).

Savings Approximately 40% based on 293 parts. Savings attributable to reduce labor cost and elimination of 4.2 lb of scrap per plate.

Source: *The Glenn L. Martin Co.*





Governor Slide Assembly

Service and fabricating requirements of this 1⅜ in. high, 1 in. wide, 6½ in. long part are such that the most satisfactory material and method can be used.

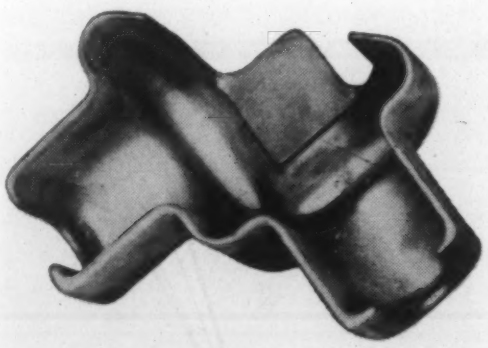
Old Made as weldment joining four separate wrought steel pieces (left).

New Now made as one-piece malleable iron casting (right).

Savings Overall savings of 46% were realized through change; 35% in manhours of labor. The additional savings over the reduction in labor costs were due to a reduction in paper work in engineering involving control and production control departments.

Source: *Caterpillar Tractor Co.*

100



Gear Cover

Covers gear on braiding machine. No critical structural requirements. Pleasing appearance for saleability. Must be reproducible in production quantities.

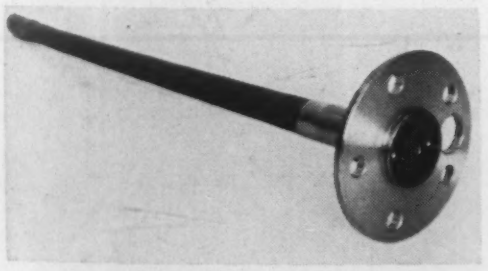
Old Fabricated from 9 pieces sheet steel; cut, shaped, assembled and butt welded.

New Gray iron casting.

Savings Approximately 90% due to elimination of fabrication operations. Also improved appearance and increased shock absorption.

Source: *Gray Iron Founders' Society, Inc.*

101



Rear Axle Shaft

The 28-in. steel shaft is flanged at one end, splined at the other. The steel must have good fatigue resistance, toughness and hardenability.

Old SAE 1330 alloy steel hardened throughout. The part was forged, quenched and drawn to Brinell 321-363 and shot peened.

New Carbon steel forged and strain drawn, normalized in center of shaft. Induction hardened with progressive heating and immediate quench. Hardening depth ⅛ in. Surface hardened to Rc 45-55, minimum Rc 40 at 0.130 in. depth. Flange not hardened. Shaft core Brinell 179-229.

Savings Raw material cost substantially reduced. Shot peening eliminated, scaling all but eliminated due to fast heat and immediate quench. The shaft is improved due to increased fatigue resistance, harder spline and bearing surface.

Source: *Ford Motor Co.*

102

103

Wing Skin Segment

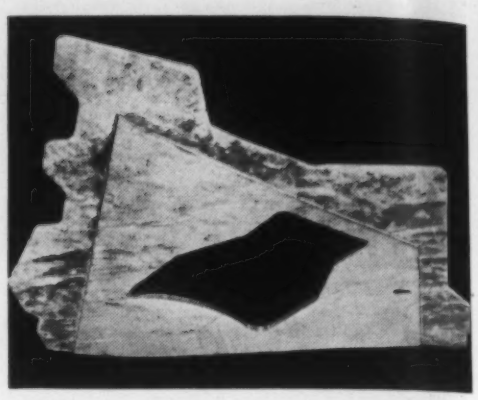
Finished skin must be 75S-T6 aluminum alloy, must contain compound contour accurately machined to various dimensions, with cut-out for refueling door. Skin made from 3/8 in. plate, approximately 30 x 33 in.

Old (1) 75S-T6 plate machined in flat condition, (2) annealed to "O" condition, (3) brake formed and hand-worked to contour, (4) solution heat treated to "W" condition, (5) hand worked to correct for warpage, and (6) age hardened.

New (1) 75S-T6 plate machined in flat condition, (2) heat to 900-920 F in electric furnace, (3) hot blank is moved from furnace to press where it is formed and die quenched in one operation, and (4) age harden.

Savings Approximately 25%. Attributable to elimination of one heat treat operation and all handwork plus reduction of multiple brake-forming operation to single die-forming operation.

Source: *Republic Aviation Corp.*



104

Toaster Parts

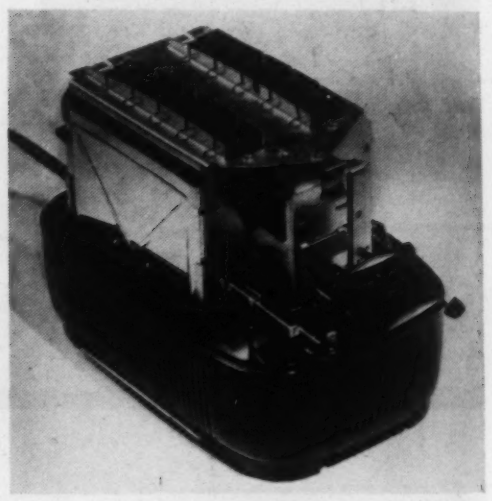
Interior parts of electric toaster; must have good heat reflectivity and durability.

Old Steel sheet stock, nickel plated, stamped and assembled.

New Hot-dip aluminum coated steel sheet stock, stamped and assembled.

Savings Approximately $100,000 per year, due to elimination of plating costs.

Source: *Armco Steel Corp.*



105

Microfinish Comparator

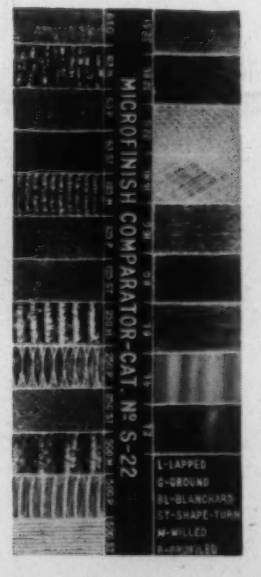
Contains 22 standard surfaces for comparative microfinish measurements. Each standard must be held within tolerances as established by SAE: 2-4 microinches, +25 —35%; 8 microinches, +20 —30%; 16 microinches, +15 —25%; and 32 microinches and above, +15 —20%.

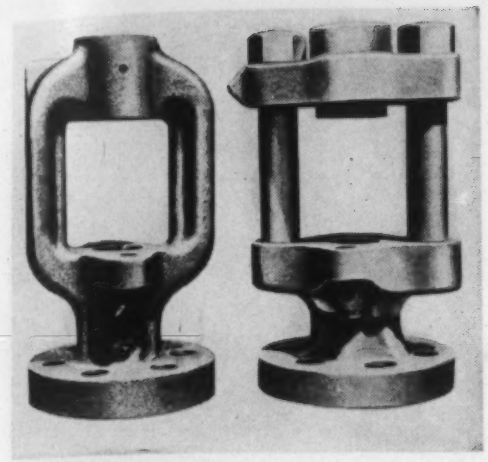
Old Each sample machined from stainless steel.

New Electroformed sheet of electrolytic nickel containing 22 samples.

Savings Electroforming process allows the production of 48 complete sets of 22 samples at one time, eliminating all machining operations. Increased purity of electrolytic nickel eliminates corrosion.

Source: *Gar Precision Parts, Inc.; Baptist Machine Co., Inc.*





Valve Yoke

106

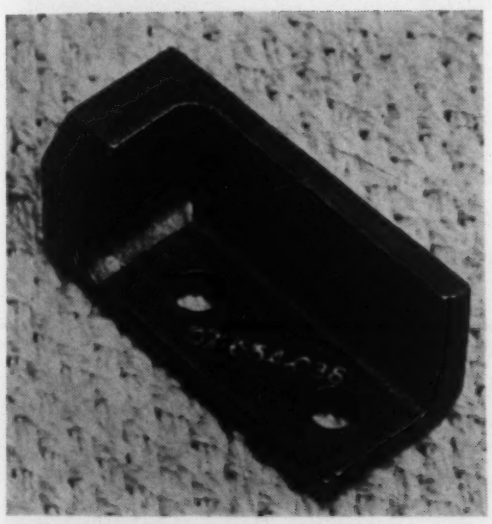
Bottom of flange is bolted to valve body and valve stem passes vertically through the yoke. Height 11 in., dia of flange 6 in. Must be strong enough to withstand bending, tension and torsional stresses imposed by turning handwheel and valve stem. Must maintain alignment of top and bottom bearings for operation of valve stem.

Old Bolted assembly consisting of 2 steel castings, 2 SAE 4140 steel strain rods and 2 hex nuts (right).

New One piece carbon steel casting (left).

Savings Unit savings per yoke $15.81 (assembled yoke cost $30.84, cast yoke cost $15.03), due to reduction in machining and material used.

Source: *Steel Founders' Society of America; Dodge Steel Co.*



Angle Nut

107

Highly stressed part; 1/8 x 7/16 x 7/16 in. angle with 1/4 in. base end for tapped hole. Four mounting holes in sides of angle. Dimensions must be held to close tolerances.

Old Machined from 4140 steel bar stock. Required cavity milling and drilling of mounting holes.

New Precision investment cast in 4140 steel.

Savings Approximately 90% due to elimination of machining, mill fixture, drill jig and machine load. Casting requires only tapping one hole.

Source: *Bell Aircraft Corp.*

Propellant Trap

108

Anti-tank rocket trap supports the rocket propellant while latter is burning. Trap must withstand severe chamber pressures plus erosive effect of high velocity hot propellant gases.

Old Precision investment cast trap made of 1020 steel, trap spacers are stampings.

New Trap and spacers stamped from steel sheet stock; holes punched or drilled with automatic production machinery.

Savings Unit savings per trap $1.00 (cast trap assembly cost $1.25, stamped assembly $0.25). Total savings on this item through Sept. 30, 1953, $26,186,000.

Source: *United States Army*

109 Oil Slinger

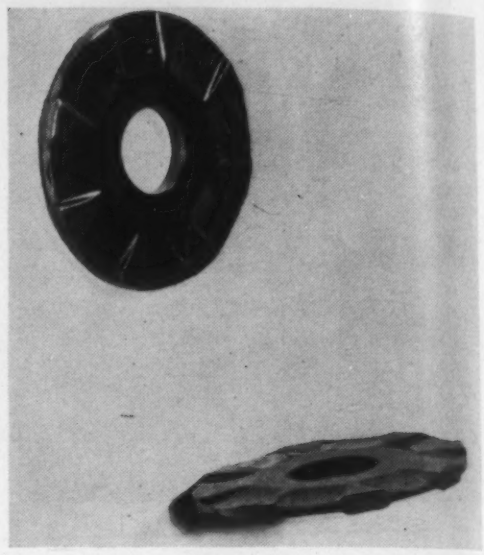
Part prevents oil from passing beyond a certain point in a rotating assembly. Tolerances must be held as follows: 1½ in. o.d. and 0.500 in. i.d. $^{+0.0005}_{-0.0000}$; thickness 0.080 in. ±0.001. Part contains 8 scallops on each side whose depth at the web must be 0.020 in. $^{+0.000}_{-0.005.}$ Faces must be parallel within 0.0002 in.

Old 4130 steel bar stock, 1¾ in. dia, turned, drilled, cut off, milled and ground.

New 4130 sheet stock, stamped to 0.093 in. thickness, pierced, blanked and coined. Bore and sides ground to dimensions.

Savings Approximately 60%, due to elimination of lathe turning and milling of scallops. Also reduction in scrap loss.

Source: *Fairchild Engine & Airplane Corp., Stratos Div.*



110 Flash Hider

Used on muzzle of 20 mm guns. Nine inches long, one end expanded to funnel shape, the other reduced to 1½ in. with threaded i.d. and hexagonal shaped o.d. Must withstand shock and heat, and be machinable to close tolerances.

Old Machined from 3-in. steel bar stock.

New Welded steel tubing with 2½ in. o.d., expanded to 3 in. at one end, reduced to 1½ in. at smaller end.

Savings Unit savings $55 (machined from stock $60, formed from tubing $5), due to reduction in machining time and scrap loss. Operation can be carried out on lower-cost-per-hour punch press instead of lathe.

Source: *Formed Steel Tube Inst.*

111 Gas Turbine Mid-Frame

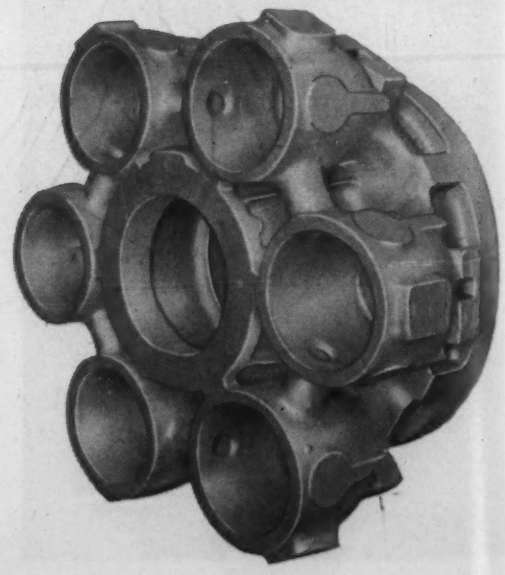
Diffuser and mid-frame for locomotive gas turbine. Thirty-eight in. dia annular ring with 6 air diffuser pots. Gross o.d. is 52 in. Must stand air from turbine compressor at 90 psig at average operating temperature of 650 F. Must have high structural strength to support load of 12 tons at 650 F, freedom from leaks, and high surface smoothness within diffuser pots.

Old Weldment of small steel castings, combined with rolled steel plate and pipe components.

New Single piece integral steel casting.

Savings Approximately 50%, due to elimination of welding, cutting and fixturing.

Source: *Steel Founders' Society of America; General Electric Co., Foundry Dept.*



Trailer Axle

112

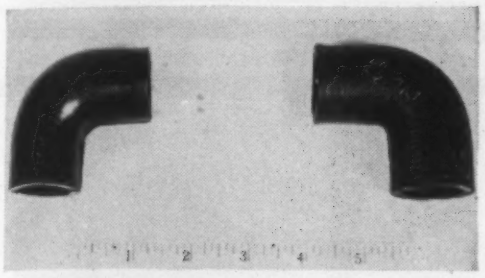
Overall length: 10 in., spindle dia: 1-3/16 in. Must have strength, good appearance and dimensional stability.

Old Five piece steel weldment.

New One piece 0.20-0.30 carbon steel casting.

Savings 28%, due to reduction in machining and assembly operations.

Source: *Steel Founders' Society of America; Superior Steel and Malleable Castings Co.*



Water Pump By-Pass Hose

113

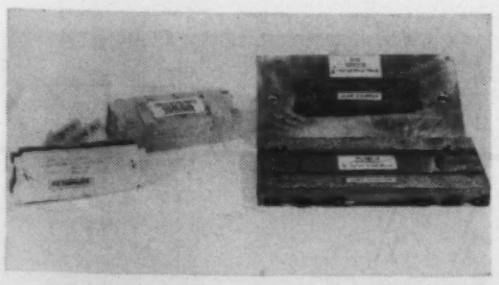
For automotive use, this hose section must carry water and various anti-freeze solutions under operating conditions of widely varying temperatures.

Old Molded Buna N (left).

New Neoprene, mandrel-cured with fabric insert (right).

Savings Mandrel curing process is less costly than molding. In addition to lowering cost, the product was improved by the fabric insert, which strengthened part against rupture.

Source: *Chrysler Corp.*



Blanking Die

114

Standard gay die type of tool used for blanking assembly door made of 0.032 in. 24S0 alclad sheet stock. Tool must produce, at high rate, blanked and pierced parts with repetitive accuracy of periferal dimensions.

Old (1) Surface grind both male and female chromium-molybdenum die material, (2) cut and file male punch to coincide with loft template, (3) saw and file mating steel female die, including clearance angle, (4) flame harden both details, (5) mount on gay die shoe, and (6) cut and glue rubber pressure and stripper pads.

New (1) Surface grind male punch from chromium-molybdenum die steel and surface grind female die from rolled Kirksite sheet, (2) cut and file male punch to loft template, (3) flame harden punch, (4) bandsaw Kirksite female sheet on clearance angle and 1/32 over-size, (5) mount male and female on gay die shoes and shear in female die, and (6) blank out sheet of cork for both pressure and stripper pads.

Savings Approximately 30% due to reduction of exacting machining and hand work operations. Die repair and resharpening is also reduced between production runs due to self-sharpening characteristics of Kirksite during normal use.

Source: *Republic Aviation Corp.*

115

Cable Drum

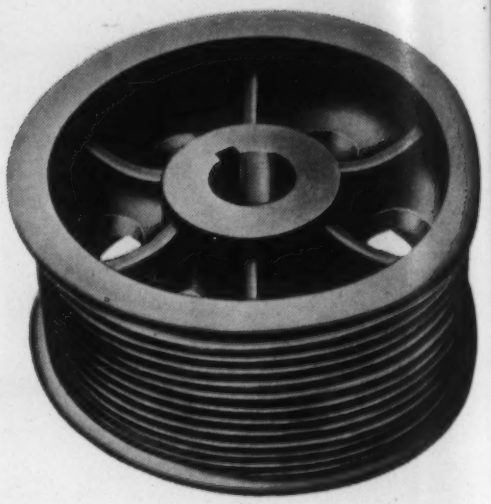
Approximately 12 in. dia, with grooves for lay of 3/8 in. cable. Must have high metal-to-metal wear resistance and non-galling characteristics.

Old About 120 lb of steel plate in varying gages, rolled, assembled and welded. Grooves then machined in weldment.

New Gray iron casting.

Savings Fabricated drum cost about $37; casting costs about $15. Reduction due to elimination of fabrication operations. Casting process was more feasible for spotty production demands for part.

Source: *Gray Iron Founders' Society, Inc.*



116

Automobile Heater Hose

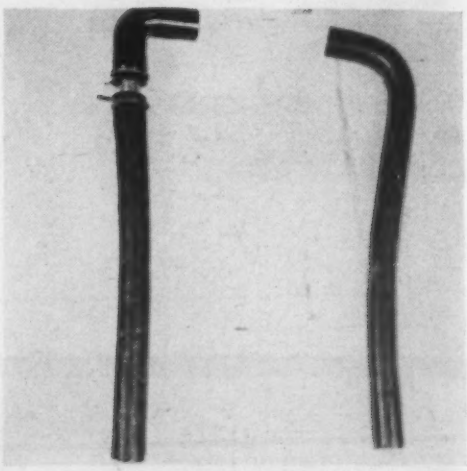
Straight section of 5/8-in. i.d. hose approximately 10 in. long with formed elbow must carry water and anti-freeze solutions from engine block to heater. Operating pressure ranges from 0 to 40 psi and temperature to slightly over 200 F.

Old Straight hose, metal link, molded elbow (left).

New One piece molding (right).

Savings Eliminated metal insert, clamps and assembly operation.

Source: *Chrysler Corp.*



117

Wave Guide Transition

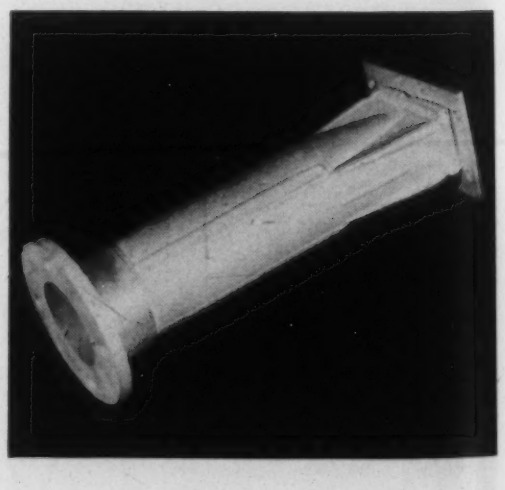
Tube is 4.96 in. long with skirted flanges at both ends. Round end is 0.900 in. i.d.; rectangular end is 1.27 x 0.502 in. i.d. Two sets of matching grooves are set on inside walls at 90 deg. Wall thickness of transition is about 0.055 in. Part must be reproducible holding tolerances on i.d. and length of ±0.001 in. Must be electrically conductive with a 32 microinch surface inside. Flanges must be parallel and flat within ±0.001 in.

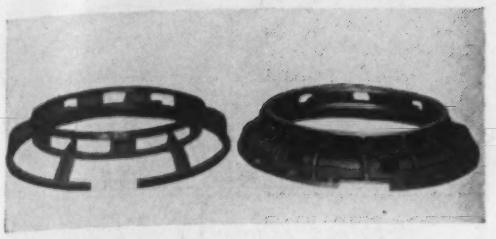
Old Fabricated by bending and drawing brass tubing and soldering or brazing flanges.

New Copper is electroformed on brass flanges and entire assembly is silver plated.

Savings Approximately 50%. Electroforming process allows accurate reproducibility of parts with a reduction in manpower. Elimination of soldering or brazing on flanges eliminates deformation problems. Inspection advantages lie in fact that o.d. of cast pattern can be checked more easily than interior of finished part.

Source: *Gar Precision Parts, Inc.*





Stator Frame

Diesel locomotive stator frame, approximately 60 in. dia, and 11½ in. high. Required tolerances: ±1/32 in fabrication; ±1/16 out of round; ±1/16 flatness and parallelism; and up to 0.005 in. on machine surface and hole locations.

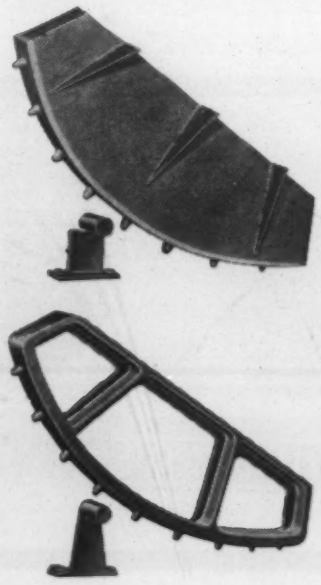
Old Aluminum casting (right).

New Fabricated steel weldment, stress relieved after welding (left).

Savings Approximately 30% due to decreased material cost which offset increased fabrication costs. Additional weight of steel is unimportant in this application.

Source: *General Motors Corp., Allison Div.*

118



Dump Hopper Rocker

Two rockers support weight of end dump hopper. Rockers approximately 30 in. long, 10 in. wide, and 3 in. thick. Must have high strength, holes for pins must be held in line tolerance of ±1/32 in.

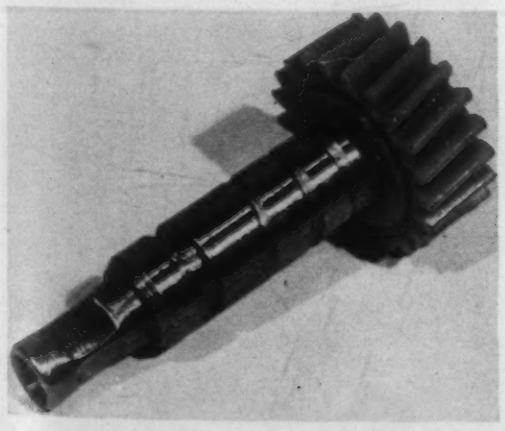
Old Weldment consisting of 13 pieces of plate steel (top).

New Cast 0.20-0.30 carbon steel, redesigned for right and left hand interchangeability (bottom).

Savings 23%, due to elimination of machining. Right and left hand interchangeability eliminated the necessity for separate right and left hand production.

Source: *Steel Founders' Society of America; Superior Steel and Malleable Castings Co.*

119



Speedometer Gear

The 20 tooth gear is ⅞ in. dia. by 0.36 in. thick. It is driven by a steel worm gear on the engine drive shaft. The gear must have exceptional wear resistance, tolerances must be within 0.002 in. for pitch diameter and total indicator concentricity reading.

Old Machined from carbon steel bar integral with shaft and case hardened. Five operations required.

New Nylon, injection molded directly on shaft.

Savings Gear machining entirely eliminated, operations reduced to one, gear wear and performance improved, scrap eliminated. Man hours reduced 50%, cost cut about 50%.

Source: *Ford Motor Co.*

120

Aircraft Wing Structure

121

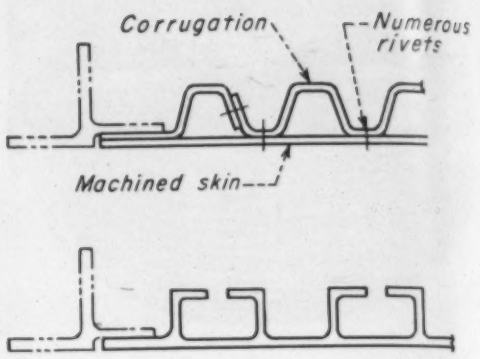
Rectangular lower center wing skin blanket, 42 in. wide and 15 ft long, with longitudinal stringers for support. Must be corrosion-resistant, able to withstand high tensile stresses resulting from bending, and rigid enough to resist buckling.

Old Skin of 75S aluminum alloy sheet riveted to corrugated skin of 14S aluminum alloy with numerous reinforcements and attachments (top).

New Integral skin and stringer structure extruded from 14S aluminum alloy (bottom).

Savings Approximately 30%, assignable as follows: 70% fewer parts (100 instead of 360); elimination of all blind rivets (1102 per assembly); 50% less riveting (5416 regular rivets instead of 11,272); and 15% lower tooling cost. Change also desirable because of the weight reduction: 14 lb per assembly or about 5%.

Source: *The Glenn L. Martin Co.*



Shock Absorber Piston Rod Guide

122

Primary requirement for part is good wear resistance.

Old Cast iron (left).

New Powdered iron pressed and sintered (right).

Savings Eliminated scrap loss, reduced machining operations. New configuration provided a self lubricating bearing surface.

Source: *Chrysler Corp.*

Autoclave Cover

123

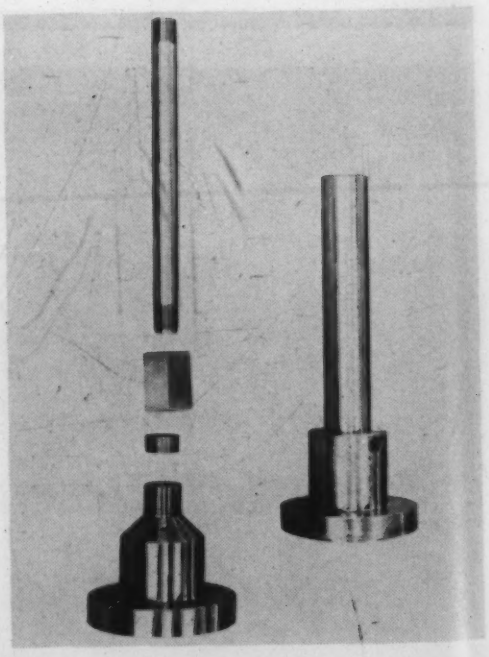
Cover and magnetic core housing for "Magnedash" autoclave having working pressures as high as 15,000 psi. Must be easily cleaned and non-magnetic. Radial fissures of throat shall not exceed 0.0025 in. and no cross-section shall have more than five defects greater than 0.0020 in.

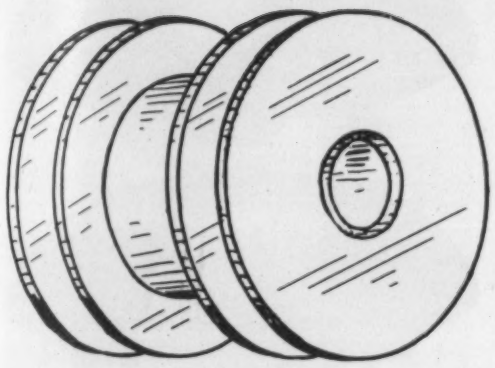
Old Machined from 2-in. Type 304 stainless steel bar stock having 38,000-40,000 psi yield strength. Throat machined to 3/4 in. on outside and deep-drilled to 7/16-in. i.d. to house magnetic core (right).

New Cold-drawn Type 316 stainless steel tubing, threaded and joined to forged and machined cover with metal-to-metal seal as shown. Tubing produced to 100,000 psi minimum yield strength (left).

Savings One-third, resulting from elimination of expensive machining and reduction of scrap loss.

Source: *Superior Tube Co.; Autoclave Engineers*





Double Pulley

Pulleys must provide high friction and at the same time not cause too much wear on the V-belts. Smoothness is essential.

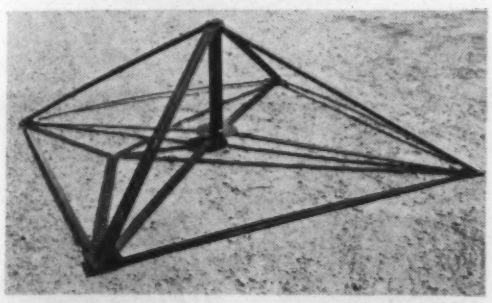
Old Pulleys of this type were made as die castings or machined from steel.

New The parts are now pressed and sintered iron powders.

Savings The processing changes provide a net saving of about 10% over previous methods. Advantages of the change in material far outshadow the savings in production cost. The part shown costs about 32¢ per piece.

Source: *United States Graphite Co., Div. of the Wickes Corp.*

124



Base for Merry-Go-Round

Must have rigidity under load for safe operation.

Old Upper leg, base and feet were iron castings, assembled and bolted.

New Welded one-piece steel frame.

Savings Approximately 50%, due to elimination of inventory of castings, elimination of nuts, bolts and spreaders and assembly time. Material is less expensive, and machining time is reduced.

Source: *Lincoln Electric Co.*

125

Oil Ring, Chromium Edged

Oil rings must be highly wear and fatigue resistant, and must be grooved or perforated to allow oil to pass through the piston wall back down to the crankcase. Chromium plating is highly desirable.

Old Rings were plated all over, or else not plated at all.

New Ring is made in three pieces, two rings and a spacer. Before assembly the rings are stacked and chromium plated so that only the outer and inner edges are chromed. The three components are assembled and held together by an adhesive until they are placed on the piston. During operation, the adhesive dissolves and the three components are free to shift around to equalize wear.

Savings Standard chromium plated oil rings, because of their relatively large surface area due to the spacer, holes and non bearing surfaces, cost 25¢ to 50¢ each, compared to much less satisfactory non-chromed oil rings, which cost from 6¢ to 10¢ each. The above ring costs about 15¢, provides the superior performance of a chromed ring at a cost savings of 40 to 70%.

Source: *Minnesota Mining and Manufacturing Co.*

126

127 Radar Reflector, Airborne

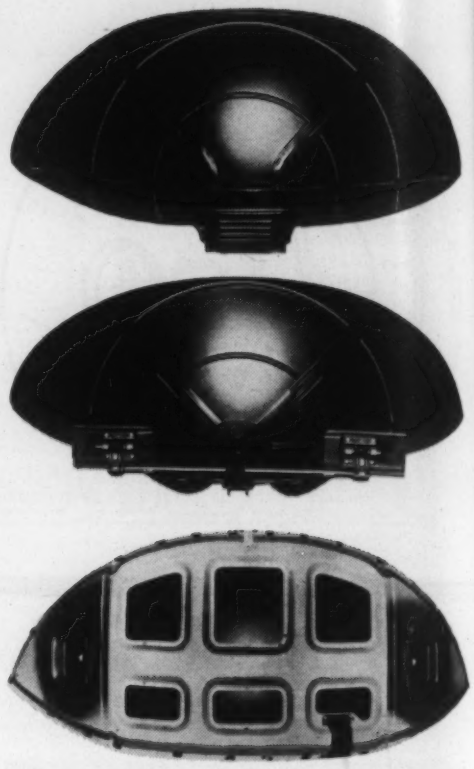
Part is about 6 ft long, must be light, rigid, and strong enough to hold shape. All three versions are made of magnesium, which is an ideal material for the part due to its strength-weight ratio and high damping factor.

Old Original part consisted of the compound curved reflector, stiffeners of magnesium extrusions bent to compound curve and welded. Second version eliminated compound curve in stiffeners by altering geometry of stiffening web so that radial arms followed spherical curve (middle).

New Magnesium sheet stamping substituted for stiffening web, assembly cherry riveted (bottom).

Savings Substitution of stamping for web eliminated difficult assembly and tube bending operations which required complex jigs. Substitution of riveting for welding permits use of less skilled labor, simpler equipment. All this resulted in substantial cost reduction.

Source: *Brooks and Perkins, Inc.*



128 Machine Base

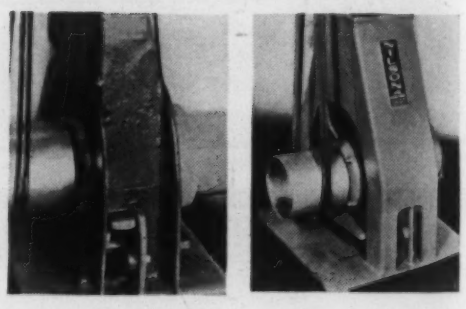
Must have high dimensional stability, withstand tensional stresses, and have design flexibility to permit meeting varying customer requirements.

Old Iron casting (left).

New Steel weldment (right).

Savings Approximately 15%, due to reduction in material cost and machining and finishing costs.

Source: *Lincoln Electric Co.*



129 Lid for Sound-Damping Shot-Box

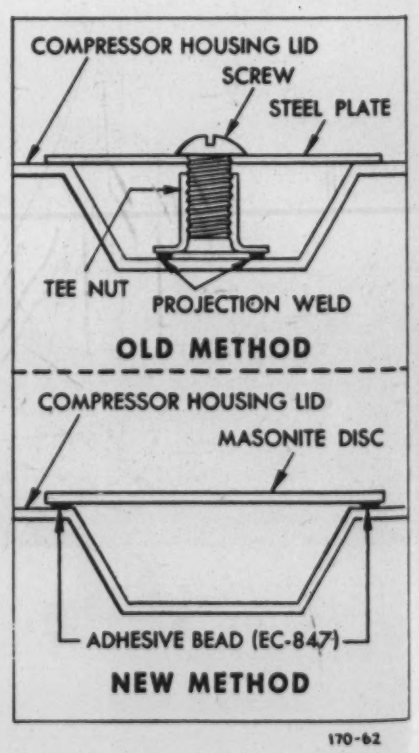
Used to cover the shot-filled cup in the top of refrigerator compressors. This is necessary to damp out vibration. Temperature range—approximately 60 to 190 F.

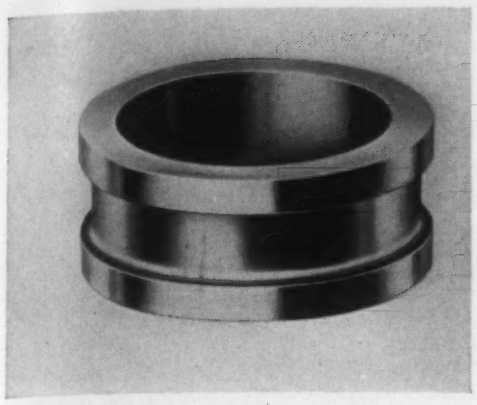
Old Steel plate with center hole, fastened with a machine screw to T-nut projection welded to bottom of depression.

New Masonite disk applied with ¼-in adhesive bead of EC 847 (3M).

Savings Eliminated T-nut, welding, fabrication of steel plate and simplified assembly. Reduction in assembly time and number of parts enables a single unskilled employee to maintain production of over 1000 parts per shift while handling the entire operation, including applying adhesive and pouring the shot.

Source: *Minnesota Mining and Manufacturing Co., Avco Corp., Crosley Div.*





Bushing

Steel Bushings of moderate size were required to be tough, wear resistant, and dimensionally accurate.

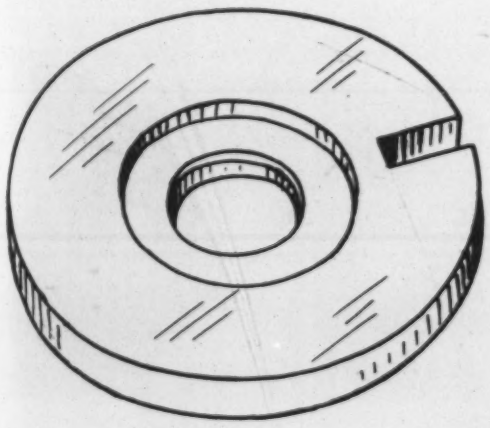
Old As previously made, the bushings were machined from steel bar stock on automatic screw machines.

New By switching to seamless tubing rather than bar stock, production on the automatic screw machine was increased from 163 per hour to 300 per hour.

Savings In addition to saving $18.21 in machining costs on every 1000 pieces produced, $18.91 per thousand pieces was also saved in materials costs by using seamless tubing rather than bar stock. Total savings on 1000 pieces is $37.12 or 34.3%. Parts now cost 7.09¢ each as opposed to 10.8¢.

Source: *Steel and Tube Div., The Timken Roller Bearing Co.*

130



Pump End Plate

Pump end plates, actual size shown, must seal the pumping element in an axial direction to maintain the required pumping pressure and/or vacuum.

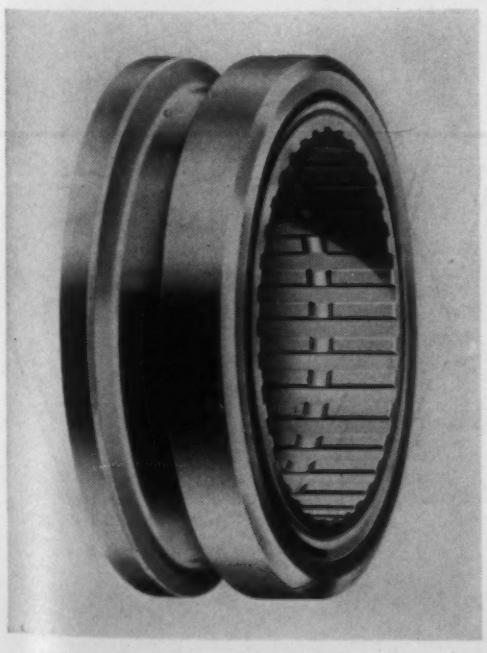
Old The part was formerly made from a bronze casting, machined on i.d. and o.d., thickness and counterbore, and then milled for a slot.

New Now the part is made by powder metallurgy using a bronze composition which contains a small amount of graphite.

Savings At a price of 10¢ per piece, the new part represents a 50% saving over parts made by older methods and the original material.

Source: *United States Graphite Co., Div. of the Wickes Corp.*

131



Steel Sleeve

The steel sleeve required a number of interior splines, plus internal and external grooves.

Old Previously, sleeves were made from forgings which cost 42¢ per unit and then required $1.29 worth of machining including broaching and automatic chucking for a total unit cost of $1.71.

New Mill lengths of seamless tubing are now broached internally and machined on an automatic screw machine.

Savings A total of 24¢ per unit was saved by switching from a forging to seamless tubing. Of this about 13¢ was saved on material cost and the remainder in machining. The parts made from tubing cost $1.47 as opposed to the previous cost of $1.71.

Source: *Steel and Tube Div., The Timken Roller Bearing Co*

132

133

Front Suspension Coil Spring

Spring is hot formed from round bar, hardened, tempered and shot peened. It must have high fatigue resistance and high yield strength to resist permanent deformation (set).

Old AISI A-9260 manganese-silicon spring steel.

New AISI A-5160 chromium spring steel. Steel producers developed this steel specifically for coil spring application.

Savings Lower material cost; shorter soak period and lower austenitizing temperature; increased die life; less scrap loss as a result of increased uniformity and less decarburization. All processing stages were speeded by the change, and since 5160 is received with better surface than 9260, quality was improved without additional processing steps.

Source: *Chevrolet Div., General Motors*

134

Truck Cab Support

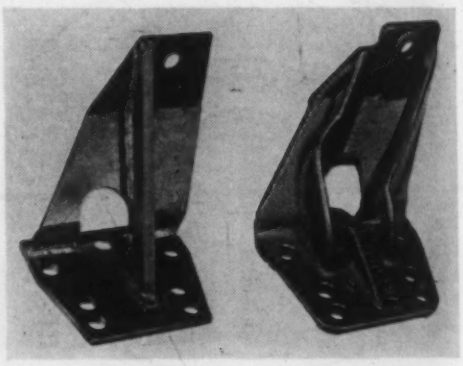
Must have high strength and rigidity to support truck cab on chassis.

Old Malleable casting (right).

New Mild steel weldment (left).

Savings Approximately 55%, due in part to reduction in material cost, and in part to replacing of machining with shear and punch operations.

Source: *Lincoln Electric Co.*



135

Spacer Block

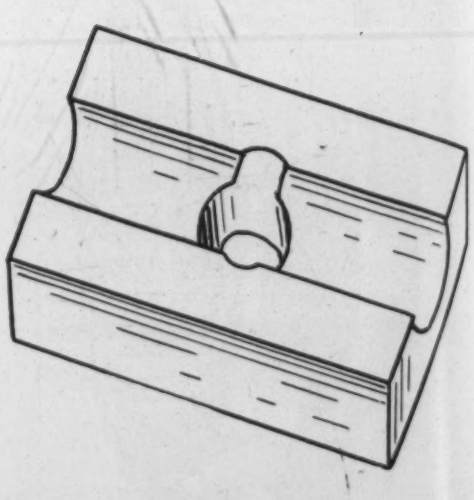
In small overhead crane assemblies, spacer blocks are required to act as sliding block bearings as well as locks on the simple chain devices.

Old Previously the blocks were cut from steel bar stock. Accurate semi-circular grooves were then milled for the entire length of each block, radial hobs drilled and the pieces then cut to accurate length.

New The completed part is now made as a sintered powder part with the complete elimination of machining. The material is an iron-copper composite powder.

Savings Savings per piece between the old and new processes have been estimated at about 75%, with the parts now costing only 8¢ per piece.

Source: *United States Graphite Co., Div. of the Wickes Corp.*



MATERIALS & METHODS

PROGRAM & DIRECTORY

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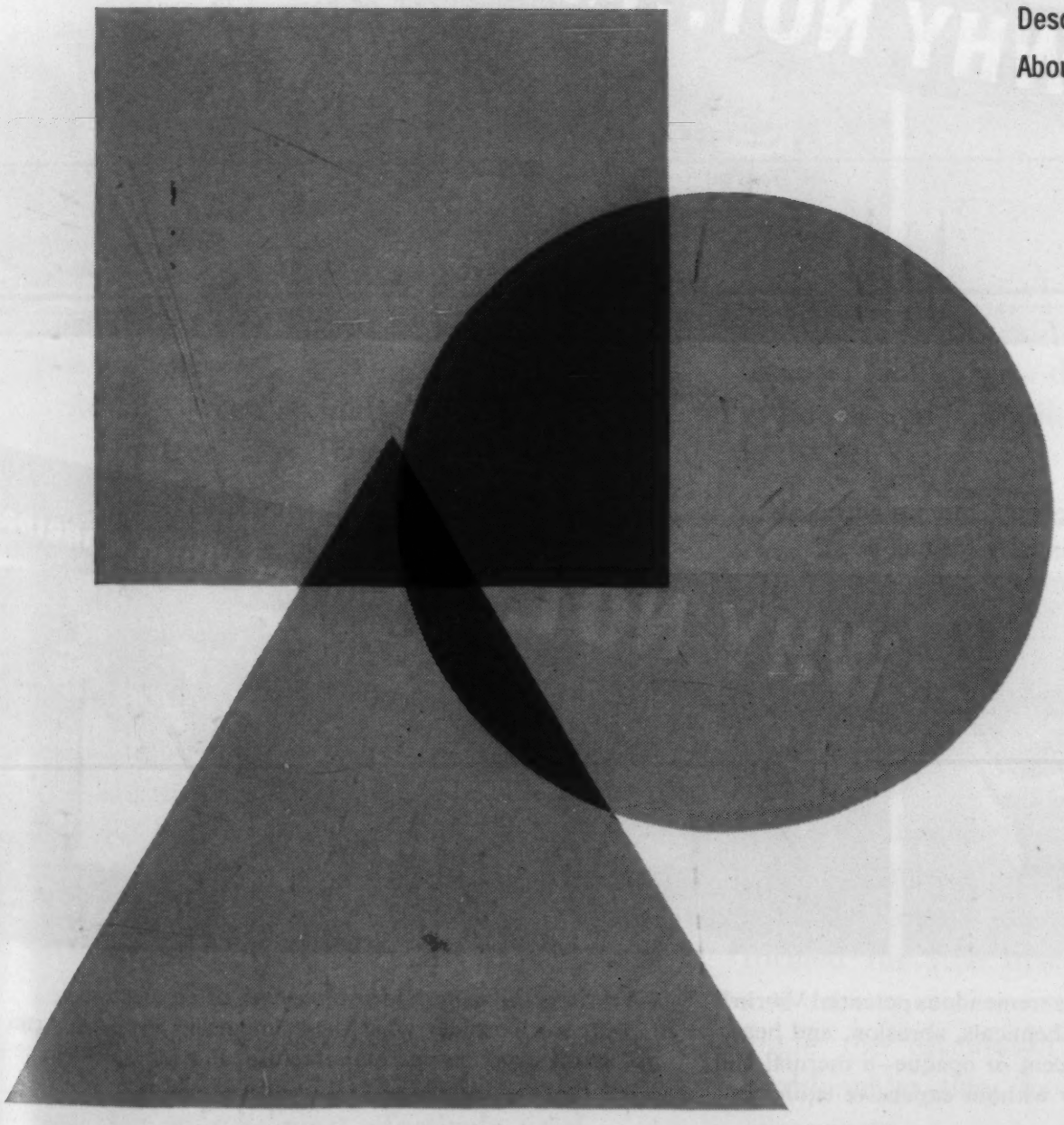


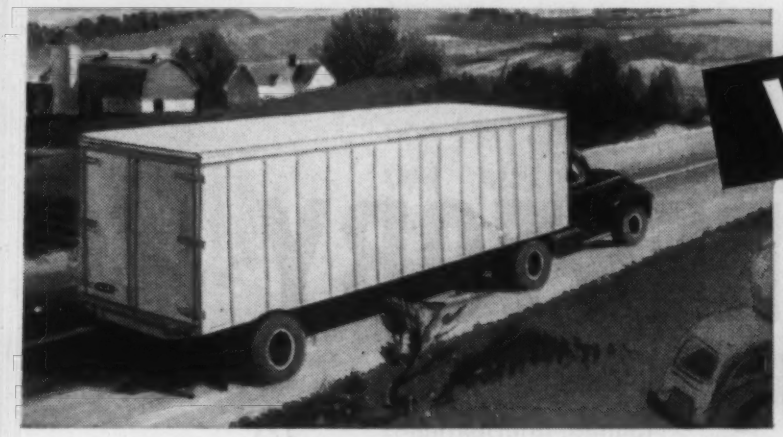
BASIC MATERIALS EXPOSITION INTERNATIONAL AMPHITHEATRE CHICAGO 1954

HERE'S WHY REINFORCED VIBRIN

...is used for Truck Trailers

Reinforced Vibrin is...

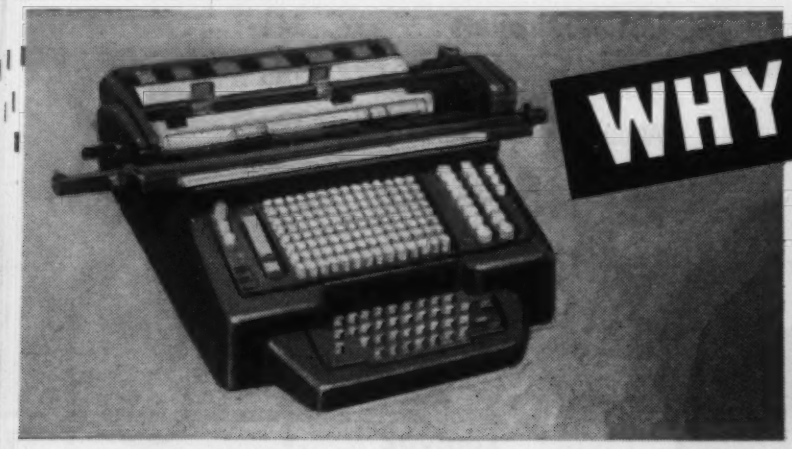
- highly resistant to shock and impact
- dent-proof—rust-proof—rot-proof
- translucent, for light, bright interiors
- stronger than steel by weight



...is used for Office Machine Housings

Reinforced Vibrin is...

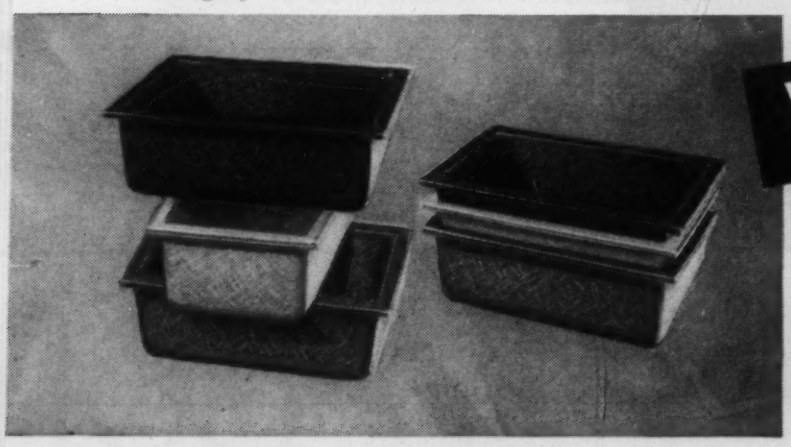
- sound deadening
- extremely light and tough
- easily molded to most contours
- oil- and chemical-resistant



...is used for Tote Boxes

Reinforced Vibrin is...

- amazingly strong and light
- impervious to most chemicals
- highly abrasion-resistant
- completely weather-proof



Industry has hardly begun to realize the tremendous potential Vibrin® polyester plastic offers. Resistant to chemicals, abrasion, and heat—non-conductive of electricity—translucent *or* opaque—a thermal and acoustical insulator—fabricated easily without expensive equipment—Vibrin is *the* material for *thousands* of applications.

Why not consider what these important properties can mean *you* in the products *you* manufacture? For more information, simply write on your letterhead to the address below.

50TH ANNIVERSARY 1904 1954 NAUGATUCK CHEMICAL

Naugatuck Chemical

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Division of United States Rubber Company
50 years of serving through creative chemistry

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • **IN CANADA:** Naugatuck Chemicals, Elmira, Ont.

For more information, turn to Reader Service Card, Circle No. 335

2nd Basic Materials Exposition Conference

Experience generally leads to improvement. Although the Second Basic Materials Exposition is constructed on the pattern of the first, opinion surveys conducted among both visitors and exhibitors at last year's show have helped in planning and improving this one. The purpose as well as the pattern is the same, namely to help you, the engineers, designers, technicians, production men and management of industry with the various materials problems which you may have.

At the International Amphitheatre in Chicago, from May 17 to 20, you will have the chance to see and evaluate the various engineering materials, both old and new, in one place and at one time. You will be assisted by technical personnel of the companies taking part in the exposition who are closest to their particular product and are the most qualified to discuss with you its most efficient use. The Conference, held concurrently and keyed to the purpose of the Exposition brings together leaders in the field of materials engineering who will discuss both the day-to-day materials problems and those likely to be encountered in the future.

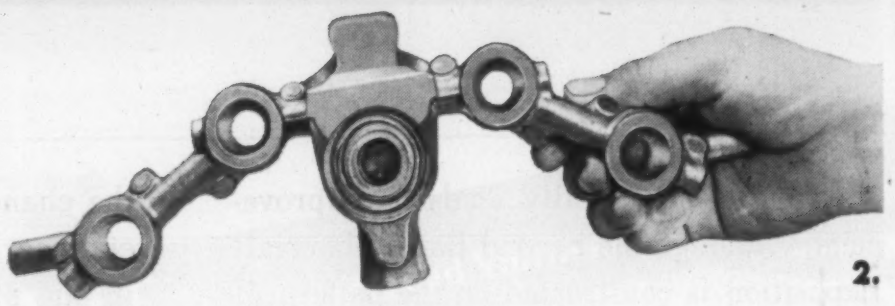
The Exposition

In the Arena and North Hall of the Amphitheatre are over 70 booths in which companies producing engineering materials are exhibiting their products and various uses for them. The materials shown include metals and alloys, plastics, ceramics, cermets, glass, industrial textiles, rubber, wood products, felts, and material parts and forms of all kinds. Included are new materials and new combinations of materials, along with demonstrations as to where and how they may be most effectively used.

Materials Conference

Experts drawn from the engineering, research, design, production and management segments of industry have been selected to speak to the conference on a variety of subjects including metal forming methods, corrosion, nonmetallic materials, joining and materials management. Panels have been formed for free discussion, and question and answer sessions will allow the visitor to angle the discussion toward his specific problems as they have arisen in his own operations.

Do You Have a Cast Part Problem that Must Be Solved Now?



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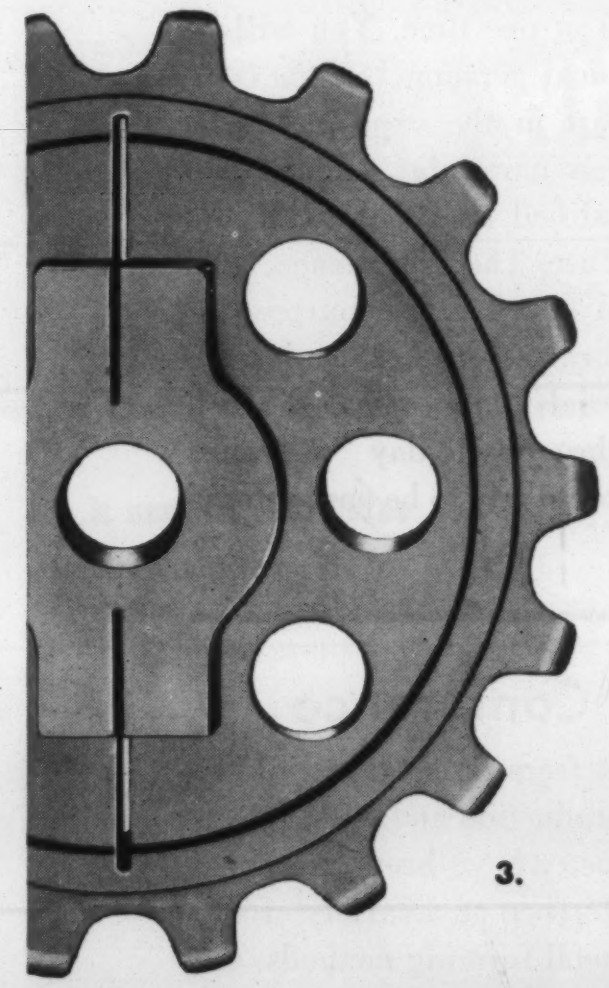

3.

A Howard representative, perhaps in your own area, helped to solve some of the production problems of these cast parts. Each part was produced by a different Howard casting process.

1. **"Lost Wax" Precision Investment Cast 11-lb. helicopter cargo hook posed a problem because of size and complex shape . . . is one of largest parts produced by this process.**
2. **Permanent Mold Cast aluminum aircraft carburetor intake manifold requires fine detail in complex shape . . . must pass 100% x-ray inspection.**
3. **Sand Mold Cast alloy iron sprocket calls for wear resistant material to give long life even though in constant contact with dry sand.**

Whatever your own cast part problem may be, it is nearer solution when you see your Howard representative. He helps solve your problems with three basic casting processes, gives you the widest selection of cast alloys in the industry today — beryllium copper, bronze, ductile iron, nickle-iron alloys, all types of steels, and virtually any aluminum and magnesium alloy.

To help you solve a cast part problem of design, material, cost or delivery, why not ask to see the Howard representative in your area today? There's no obligation.

SEE OUR EXHIBIT AT THE BASIC MATERIALS EXPOSITION, BOOTH 228 & 232, CHICAGO, MAY 17-20

CUT OUT AND MAIL ATTACHED TO YOUR BUSINESS LETTERHEAD

WE WOULD APPRECIATE DISCUSSING FOUNDRY ENGINEERING OF ONE OF OUR PARTS WITH THE HOWARD REPRESENTATIVE IN OUR AREA

NAME_____

POSITION_____

HOWARD FOUNDRY COMPANY

General offices:
1702 North Kostner Avenue • Chicago 39, Illinois

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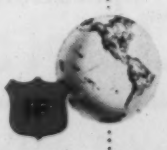
WE LIKE TO BE KNOWN BY THE CUSTOMERS WE KEEP



For more information, turn to Reader Service Card, Circle No. 436

General Information

Conference Sessions

The Second Basic Materials Conference will be held on Monday, Tuesday and Wednesday, May 17, 18 and 19. All sessions will be held in the Saddle and Sirloin Club adjacent to the International Amphitheatre.

Conference Hours

The morning sessions will start at 10:00 A.M., concluding at 12:00 Noon. Afternoon sessions will start at 2:00 P.M., concluding at 4:00 P.M.

Exposition Hours

The Exposition will be open on Monday, Wednesday and Thursday, May 17, 19 and 20 from 10:30 A.M. to 5:30 P.M. On Tuesday, May 18, it will be open from Noon to 10:00 P.M.

Admission

Registration for the three days of the Conference is $20. This fee includes a bound volume of the Proceedings of the Conference. One-day registration fee is $10, Proceedings not included. Registration prior to opening day may be arranged through the owners and managers of the Exposition, Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. There is no registration fee or charge for admission to the Exposition.

Men Behind the Show

A listing of the members of the Board of Sponsors for the Second Basic Materials Exposition will be found on page 125. The members of the Conference Advisory Committee are listed on page 127.

Exhibiting Companies

The names of the exhibitors and the numbers of their booths at the Exposition will be found on page 141. A brief description of the display in each of the booths can be found starting on page 145, indicating the purpose of the exhibits.

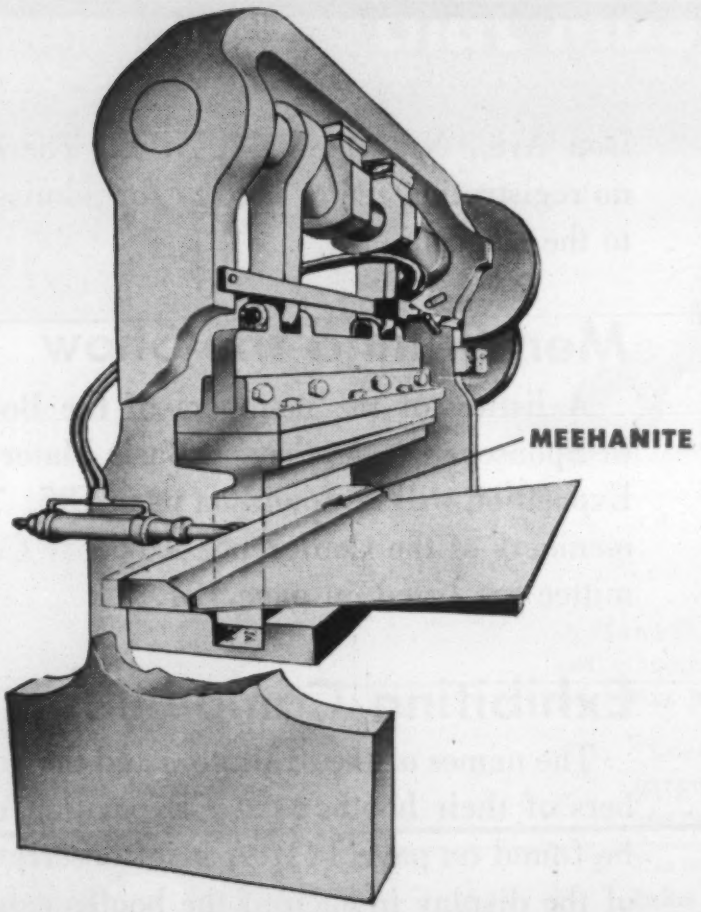
Materials Conference

Included in the Conference program which may be found on page 133, are brief introductions to the subjects covered in each session along with the names of the chairmen of the sessions and the titles and authors of the papers to be presented. Starting on page 194 are brief biographical sketches of the authors of the papers presented at the Conference.

(Program continued on page 125)

The MEEHANITE® Casting Reporter

METAL®



MEEHANI
BACK GAGE SAV
$100 PER D

In order to reduce production costs on a power bra the manufacturer devised an automatic flanging with a movable back gage which permitted the fo ing of 6 different bends with a single set-up. Materi handling savings amounted to $100 per day.

Originally the back gage, key to the operation, made of hardened and ground steel but wore rapi as a result of the horizontal thrust of the sharp ed of the steel sheet being worked.

The use of Meehanite metal for this gage sol the wear problem and three years after the insta tion the unit had gone through 9 million operati without removal for maintenance, repair, or straig ening.

The manufacturer states **"The ability Meehanite metal to meet the service requirem permitted the successful design and operatio the machine."**

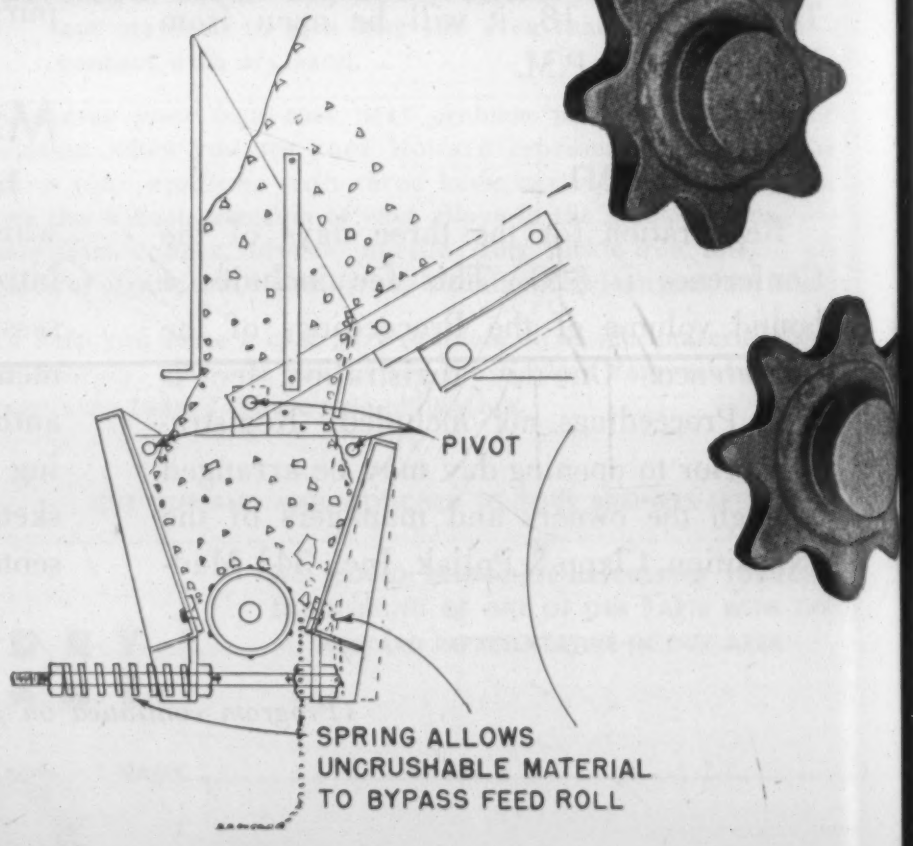
MEEHANITE SPROCKET INCREASES SERVICE LIFE THREE TIMES

In a sand and cinder spreader used for skid-proofing icy roads the operation of the material hopper is dependent upon a drive sprocket unit. The material being spread is fed between a feed roll and compression springs allow movement of the hopper sides in the event of hard, uncrushable pieces being passed.

The drive sprocket, when cast in high property bronze gave trouble through shearing at the clutch face when subjected to the high stresses created when hard and large lumps of material went through the hopper.

When produced as a Meehanite casting, the sprockets, after heat treatment, provided sufficient impact strength and abrasion resistance to eliminate breakage.

The manufacturer reports **"that substantial cost savings have resulted and the operating life of the Meehanite sprocket is generally three times that of the previous material."**



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Basic Materials Exposition

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Cast in Lightweight Aluminum

in the foundries of

ALUMINUM INDUSTRIES, INC.

FANTASTIC? We-e-ll, maybe a little . . . but only a little! Aluminum, the magic metal of the 20th century, can easily become the *irreplaceable* metal of the age of space travel!

We at Aluminum Industries, Inc., are proud of the part our foundry has played in developing and producing aluminum castings for aircraft, for ordnance units, for automobiles, and for a vast variety of peacetime products during the past 34 years.

We expect to keep at it right on into the age of space ships, but in the meantime . . . perhaps we could serve *your* aluminum castings requirements.

Our aluminum foundry is one of the largest and most modern in the world. We have ample facilities for quantity production of either Sand or Permanent Mold Aluminum Castings. Our Physical and Metallurgical laboratories, our X-ray facilities, and our own genuine passion for top quality guarantee you workmanship of the highest order.

Our engineers are at your disposal if you have a design or structural problem which lightweight parts may solve.

Ask for recommendations and estimates.

This complex supercharger housing is an aluminum sand casting with wall thicknesses down to 3/16". By the permanent mold process, it is possible for Aluminum Industries to produce aluminum castings with 1/8" wall thicknesses and dimensional tolerances to within ±.010".

ALUMINUM INDUSTRIES, INC.
Cincinnati 25, Ohio
Detroit: 809 New Center Bldg. *Chicago: 64 E. Jackson Blvd.*

PERMITE Aluminum Castings

ALUMINUM PERMANENT MOLD and SAND CASTINGS . . . HARDENED, GROUND and FORGED STEEL PARTS

For more information, turn to Reader Service Card, Circle No. 374

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Editor, Materials & Methods Magazine

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Basic Materials Conference

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John B. Seastone, *Consulting Engineer, Westinghouse Electric Corp.*

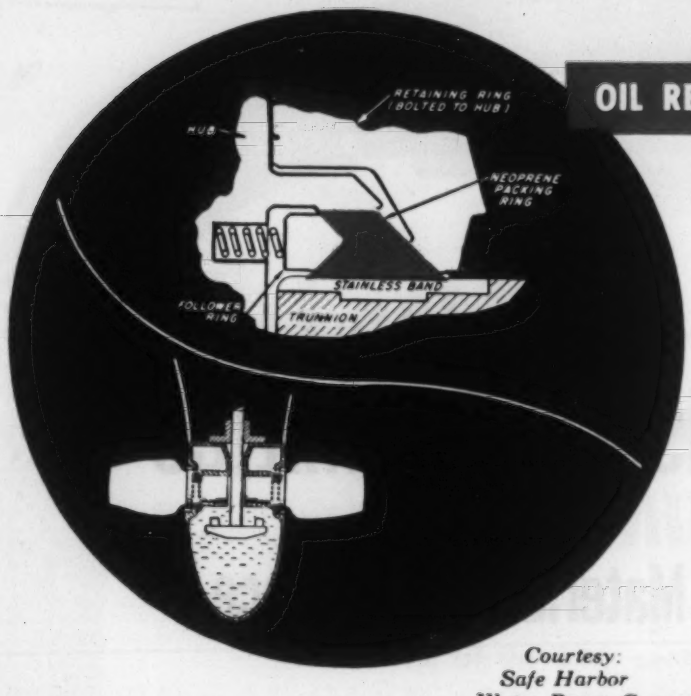
W. A. Stadtler, *Manager, Technical Services Laboratory, International Business Machines Corp.*

F. F. Vaughn, *Plant Metallurgist, Caterpillar Tractor Co.*

R. A. Wenneker, *Chief Materials & Processes Engineer, McDonnell Aircraft Corp.*

(Program continued on page 131)

Neoprene's remarkable properties



Courtesy:
Safe Harbor
Water Power Corporation

OIL RESISTANCE | **ABRASION RESISTANCE** | **LOW COMPRESSION SET**

These properties of neoprene assured efficient operation of this HYDROTURBINE

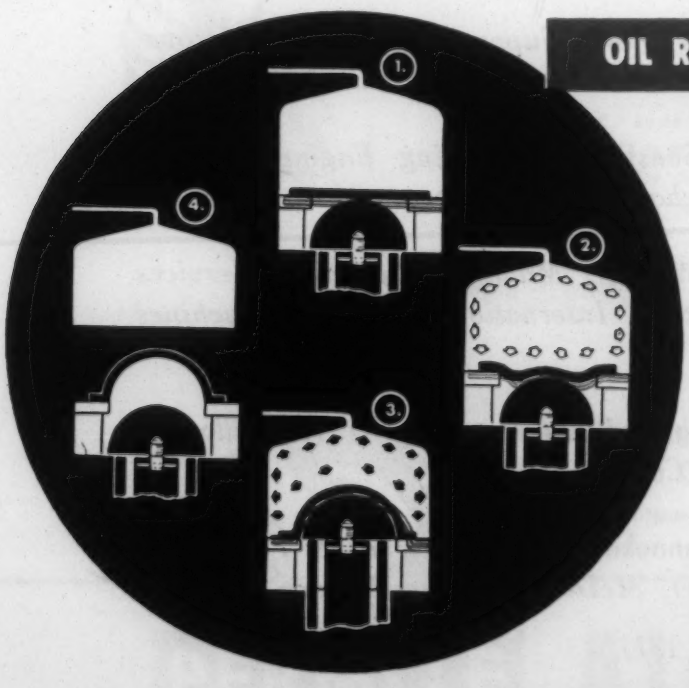
Encircling each trunnion of this hydroturbine is a neoprene packing ring. As the blades change pitch, the ring seals oil in and water out by pressing against the hub and a steel band on each trunnion. This key neoprene part resists attack from oil and grease . . . stands up under constant abrasion. And neoprene's low compression set assures that the tight seal will continue for years despite continuous pressure.

LOW COMPRESSION SET | **CHEMICAL RESISTANCE** | **ABRASION RESISTANCE**

These properties of neoprene made a more effective BUTTERFLY VALVE

The secret of this valve's perfect closing action—against low pressure or vacuum—is a resilient neoprene seat. When the valve is closed, this seat exerts positive pressure against the disk. If solid matter is caught between seal and disk, the seat deforms around it and the seal is maintained. And since neoprene resists abrasion, oils and chemicals, the valve can be used in a wide variety of applications.

Courtesy
Keystone
Tool Corporation,
P. O. Box 6716,
Houston 5, Texas



OIL RESISTANCE | **ABRASION RESISTANCE** | **FLEXIBILITY**

These properties of neoprene improved the operation of this HYDROFORMING PRESS

In this method of metal forming, a neoprene diaphragm backed by hydraulic oil acts as a universal female die. A metal blank is placed on a draw ring and the upper forming cavity, faced with the diaphragm, is locked in position (Fig. 1). Hydraulic pressure is increased (Fig. 2). The die punch is forced against the diaphragm into the forming cavity, wrapping the blank around the punch (Fig. 3). The cavity is raised, and the finished part stripped from the punch (Fig. 4). Even after thousands of such cycles, rugged diaphragms of neoprene remain resilient and free from cracks.

Basic Materials Conference

Foreword

In the year which has elapsed since the First Basic Materials Conference we find that many of the same materials problems which confronted industry then still persist. In addition, a new set of conditions has been imposed through the return of our economy to one of intense competition. One segment of industry must look forward to new materials—perhaps now unknown—while a much larger group must learn better ways to use the materials now available.

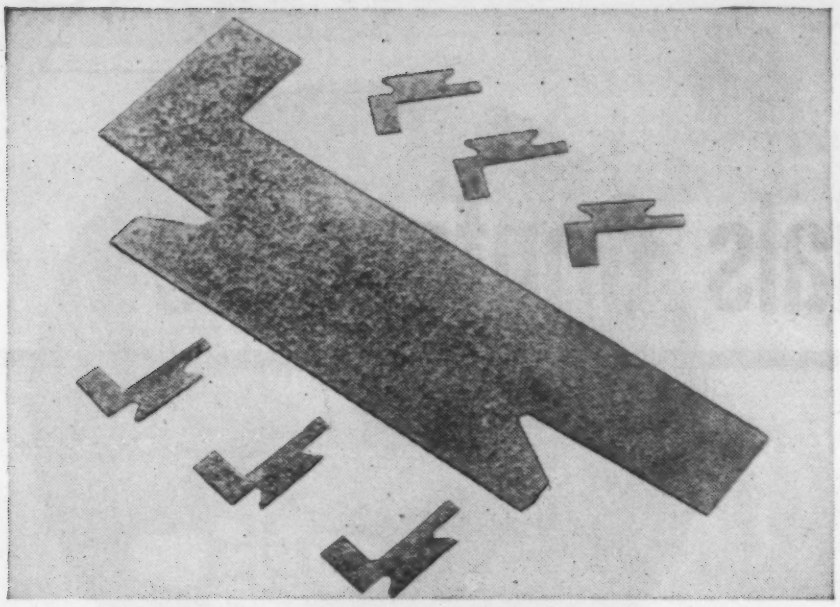
Both industrial groups have been kept in mind in setting the program and in selecting the speakers for the Second Basic Materials Conference. While looking to the future, as shown to us by the engineering developments in rockets and guided missiles, we cannot lose sight of the everyday problems in materials facing those making more prosaic products. Problems in building rockets and jet planes are vastly different from those involved in making adding machines or trains; but the interchange of information on materials used in the former is likely to help in making the latter better.

Competition which has existed among engineering materials in recent years is now being intensified. The same holds true among processes required to convert materials into useful products. All have their places in industry, but the advantages of the new materials and fabricating methods are not as well understood as they should be. Reduced product cost or improved quality at equal cost can be the result of proper selection of engineering materials and forms in which they are used.

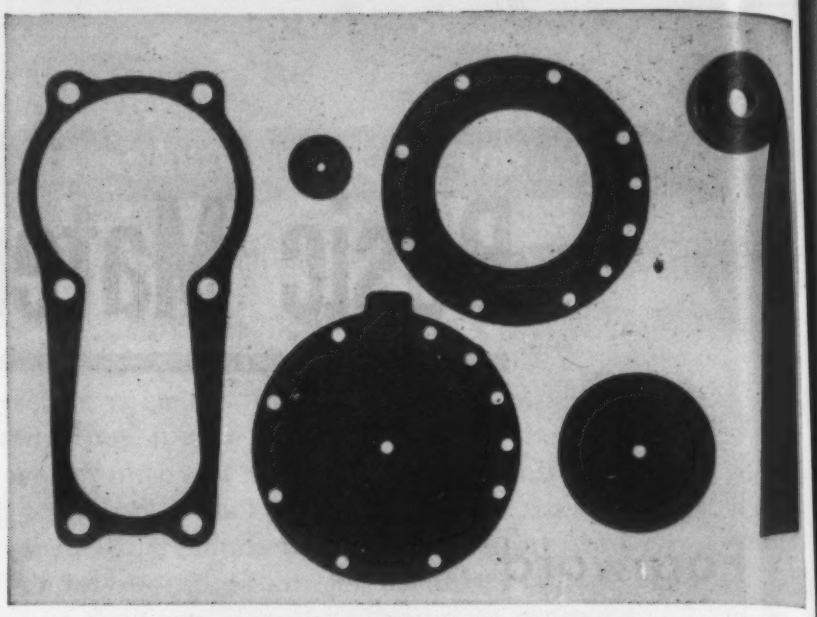
New concepts of the place of materials in our engineering scheme of things are being established today in many industries. Managements are realizing that the choice of a material is not a casual matter, but rather one which must be backed up by sound knowledge of the materials themselves, the ways in which they can be used, and above all, how they will behave under widely varying conditions. Much of this knowledge can be attained at a Conference such as the one in which you are now about to participate.

T. C. DuMond, *Conference Chairman*

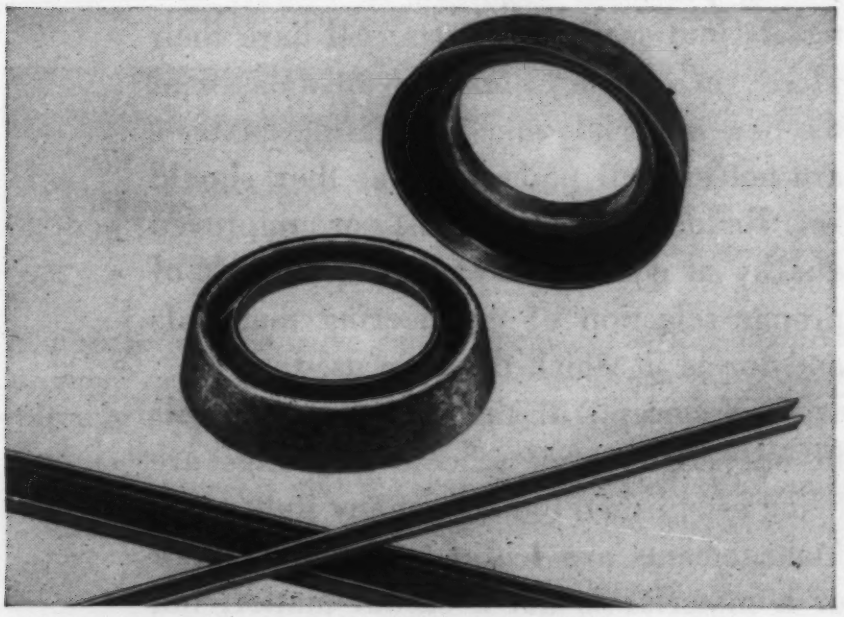
Do you have Class H insulation problems?



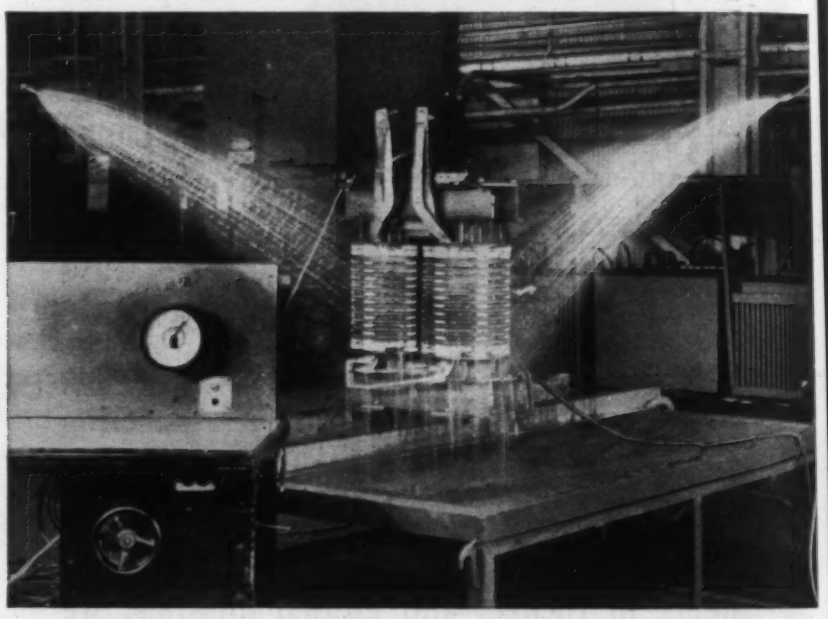
1. Need a Class H segment plate that's easy to work with? ISOMICA® Segment Plate—made of built-up continuous mica sheet—shows no tendency to split or flake. Small segments of heavy thickness may be punched, and larger segments can be accurately sawed, milled, punched, etc.



2. Need rubber-like properties for long periods of time under extreme temperatures? EMPIRE® Silicone Rubber Coated Glass Cloth — Class H insulation — is suitable for a temperature range of —70° F to 400° F . . . will not crack or become brittle under these operating temperatures . . . offers good chemical resistance.



3. Looking for a Class H molding plate? Silicone molding plate which could not be produced successfully with mica splittings can now be manufactured from ISOMICA (continuous built-up mica sheets). ISOMICA silicone molding plate has excellent moldability . . . excellent retention of shape . . . high degree of homogeneity.



4. Need reliable silicone-glass, silicone-asbestos and silicone-rubber-glass insulating materials? Twice the amount of water ordinarily applied for bushing flash-over tests was sprayed on this Class H Core and Coil Assembly, which was under full voltage excitation. The MICO insulation was unharmed.

When *you* turn to Class H, take advantage of MICO's experience in this fast-moving field. MICO has the finest equipment in the country for producing extremely high quality silicone fabrics, silicone laminates and silicone-mica combinations.

MICO produces a complete line of Class H insulating materials in addition to all standard types... and fabricates special parts to specifications. We will be glad to consult with you about your electrical insulation problems. Write today.

Visit our booth — #123 — at the Basic Materials Show May 17-20 International Amphitheater, Chicago

MICA *Insulator* COMPANY

Schenectady 1, New York

Offices in Principal Cities

In Canada—Micanite Canada, Ltd., Granby, Quebec

LAMICOID® (Laminated Plastic) • MICANITE® (Built-up Mica) • EMPIRE® (Varnished Fabrics and Paper) • FABRICATED MICA • ISOMICA

For more information, turn to Reader Service Card, Circle No. 476

Program

All Sessions to be Held in Saddle and Sirloin Club (Adjacent to Amphitheatre)

Monday, May 17, 10:00 A.M.

Subject: Materials of the Future

Most of the future problems concerning the use of engineering materials can be found in one small package known as a rocket. What the problems are and what materials are now being used will be discussed by a leading engineer in the field of rocket development. Information he divulges will be of major interest to all users of engineering materials.

Chairman: **T. C. Du Mond**, Editor, MATERIALS & METHODS

Review of New Developments in Engineering Materials—**T. C. Du Mond**

Rockets and Guided Missiles—How New Materials for Weapons Can Help Industry—**Carson E. Hawk**, Head, Development Dept., Liquid Engine Div. Aerojet-General Corp.

Question and Discussion Period

Monday, May 17, 2:00 P.M.

Subject: Corrosion

The cost of product failure due to corrosion is estimated in billions of dollars per year. Many more millions are spent each year in searching for methods of controlling corrosion. What are some of the things being done to minimize these problems? This entire session is devoted to answers to that one question.

Chairman: **R. B. Mears**, Manager, Research and Development Laboratory, United States Steel Corp.

Corrosion—How to Combat It—**Sam Tour**, President, Sam Tour & Co., Inc.

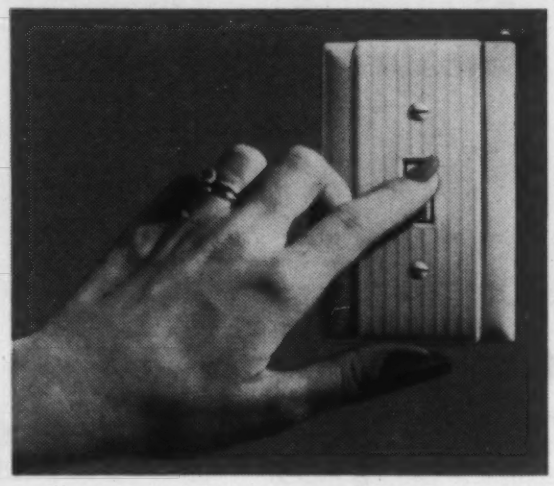
Question and Discussion Period

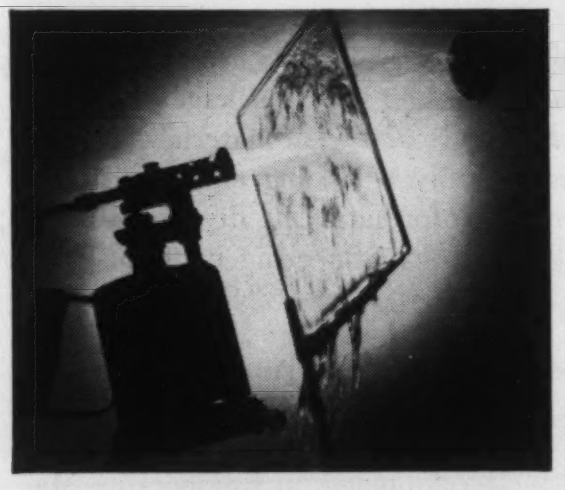
CORNING GLASS BULLETIN

FOR PRODUCT DESIGNERS

Tricky welding problem solved. Sometimes you back into a problem. For instance, heat generated by welding instrument panels into place was raising havoc in a plant where they assemble flying machines.

Glass windows used in the panels had to be mounted *before* the welding trick, but invariably they broke under the high temperatures the welding generated. Racking his brains for a solution to this vexing problem, someone thought of trying one of the VYCOR brand glasses. It worked. Now welders weld away to their heart's content without thought of setbacks from breaking glass.





A piece of VYCOR brand glass takes the heat from a blowtorch on one side and a cold water spray on the other without cracking or melting.

The ability of VYCOR brand 96% silica glass to stand up under remarkably wide variations in temperature—from below freezing to 1800° F.—makes it an exceptionally useful material. Our technical men attribute this ability to what they call "special thermal properties." We think you'll get some idea of just how much of this "thermal" stuff it's got from the picture above.

▶ An interesting piece entitled, "*Glass that laughs at heat*" tells a lot more about this fascinating material. We will be glad to send you a copy.

Glass that clicks because it doesn't. Elusive mercury (the only metal that flows at room temperature) helps take the click out of some electric wall switches.

But, it's a PYREX bulb no bigger than an unshelled peanut that keeps the mercury in line. Result—silent light from switches that don't click when you flick.

In all honesty we must admit we don't make this ingenious little bulb. What we *do* supply is the PYREX tubing to make the bulb that makes the silent switch.

How come *glass* for this tough but delicate service? Well, first of all, mercury being corrosive (as well as elusive) unites with most materials —but *not* with nonporous glass. Then, there's the little matter of insulation, not to be overlooked when directing traffic through electrical circuits. And, to frost the cake, glass (as you've probably found out) is often made so you can see through it. See-through-ability in this case makes inspection of the finished product quick and sure. And finally, glass can be joined to metal.

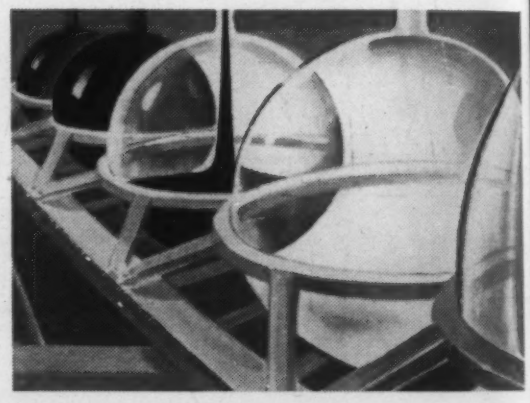
The glass used in the silent mercury switch is made from one of the more than 50,000 glass formulas on tap at Corning. Each formula has been developed in the search for just the right balance of mechanical, chemical, thermal, and/or electrical properties to satisfy some specific design or use problem. Maybe one of them can serve you.

▶ Any time you'd like to get a little deeper into the myriad uses to which product designers and engineers are putting glass, we'd be glad to aid your cause. The profusely illustrated booklet, "*GLASS and You*" gives a comprehensive picture of glass at work and play. Drop us a line and we'll whisk your copy on its way.

How to obsolete an elephant. When billiard balls aren't made of elephant ivory, chances are they're made of plastic.

After searching for a better molding material, a couple of billiard ball makers are now using glass with quite some success. Taking their cue from these game firms, others have also found glass molds useful in making plastic products with a minimum of fuss—precision items such as insulators for the radio and TV industry, and catheters to aid the cause of medicine are examples.

What's really important isn't so much what's being made in glass molds, as what has been proved about them. For one thing, because glass is nonadhesive, the plastic material doesn't stick to the mold—nor the mold to the plastic material. And when they're made in large enough quantities, glass molds are inexpensive enough to be expendable—just crack 'em off and throw 'em away when the plastic is set.



Sketch showing how billiard balls are molded in glass. When the plastic is set and cured, glass mold is simply cracked off and ball is ready to finish.

Glass molds can cut processing cost, too. Since products come out so smooth, they require less finishing. You can even hasten curing time by using dielectric heat.

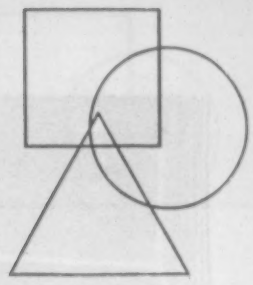
▶ If plastic molding is on your mind, maybe you'll want to learn more about putting glass to work. Why not tell us what you have to mold and see if we can supply the answer.

If the items discussed here seem unrelated to your problem, we still may have what you need at our fingertips. We'd count it a pleasure to hear from you.

Corning means research in Glass

CORNING GLASS WORKS 12 Crystal St., Corning, N. Y.

For more information, turn to Reader Service Card, Circle No. 497



Tuesday, May 18, 10:00 A.M.

Subject: The New Metal Forming Processes—How, When and Where to Use Them

When a new method of forming metals comes along, it is of general interest to all engineers. However, it is usually too long before most engineers take advantage of the opportunities to reduce costs and improve quality by adopting the new methods. Lack of knowledge of where, when and how to use the processes is the principal reason. Experts on this panel can tell when as well as when not to use the processes they describe.

Chairman: **J. H. Jackson,** Manager, Metallurgy, Battelle Memorial Institute

New Casting Techniques—**Lyle M. Christensen,** Casting Design Consultant, Northrop Aircraft, Inc.

Powder Metallurgy—**Dr. H. H. Hausner,** Atomic Energy Division, Sylvania Electric Products, Inc.

Forging, Stamping and Extruding—**J. Walter Gulliksen,** General Superintendent, Worcester Pressed Steel Co.

Question and Discussion Period

Tuesday, May 18, 2:00 P.M.

Subject: How, When and Where to Use Nonmetallic Materials

When metals become scarce, industry looks to nonmetallic materials to fill the void. However, most of these materials have properties which should suggest their use for many applications at any time. For a better understanding of when and where to use nonmetallic materials, a panel has been assembled to speak and answer questions on their specialties.

Chairman: **Charles D. Leedy,** Design Engineer, Test Equipment, Bendix Products Div., Bendix Aviation Corp.

Plastics—**Dr. Jesse H. Day,** Editor SPE Journal

Carbon and Graphite—**Fremont F. Ruhl,** Sales Manager, United States Graphite Co.

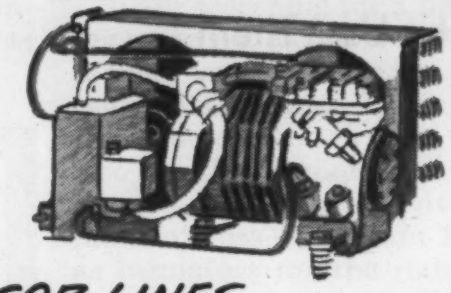
Ceramics—**Dr. John H. Koenig,** Director, **Dr. Edward J. Smoke,** School of Ceramics, Rutgers University

Glass—**W. H. McKnight,** Supervisor of Development Engineering, Corning Glass Works

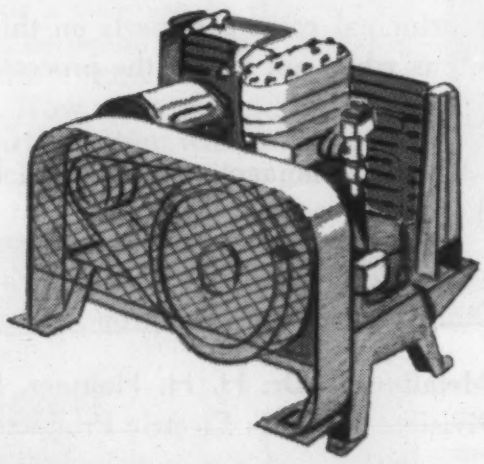
Rubber— **Dr. J. H. Faull, Jr.,** Consultant to Office of Naval Research, Navy Dept., on Elastomer Research and Development.

Question and Discussion Period

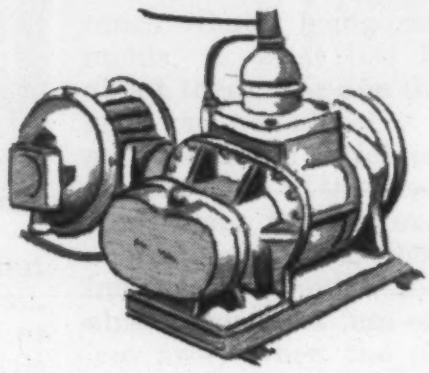
FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*



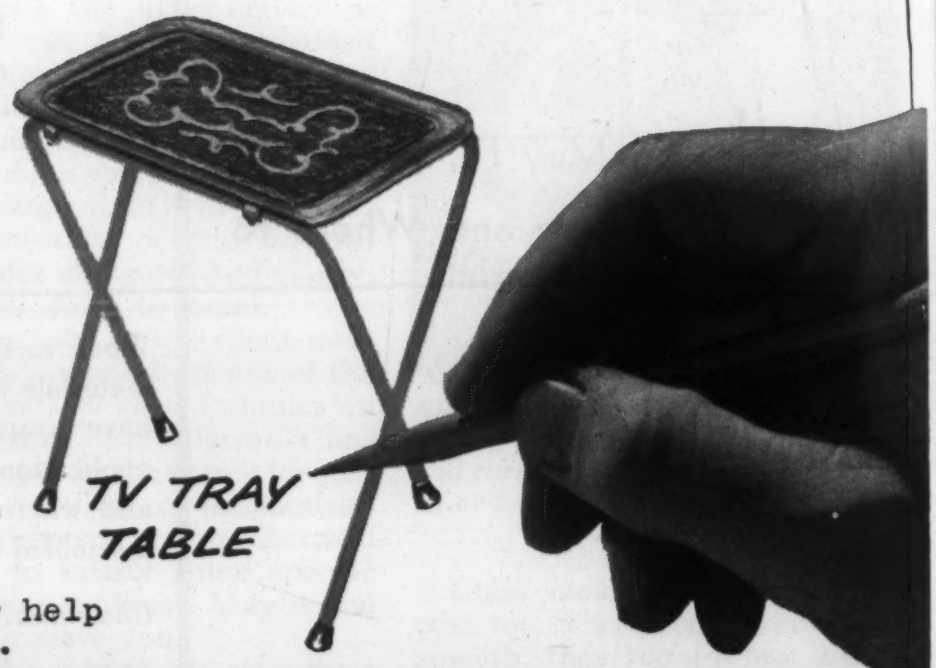
COMPRESSOR LINES



SERPENTINE COILS IN CONDENSER UNIT



VACUUM PUMP LINES



TV TRAY TABLE

REMARKS Is that cost-saving idea wasting away in a notebook? Then why not let expert Bundy engineers help bridge the gap between idea and finished product. They offer you specialized engineering skills, unmatched fabrication facilities, plus the priceless extra of Bundyweld, the only tubing double-walled from a single strip (see below).

WRITE today for catalog for help in developing your tubing ideas.

BUNDY TUBING COMPANY, DETROIT 14, MICH.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof	Lightweight
High thermal conductivity	Machines easily
High bursting point	Takes plastic coating
High endurance limit	Takes plating
Extra-strong	Bright and clean
Shock-resistant	No inside bead
Ductile	Uniform I.D., O.D.

Bundy Tubing Distributors and Representatives: ***Bridgeport, Conn.:*** Korhumel Steel & Aluminum Co., 117 E. Washington St. • ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.,*** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., W.

Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

For more information, turn to Reader Service Card, Circle No. 339

Wednesday, May 19, 10:00 A.M.

Subject: Joining

The aviation industry, which has been quick to adopt most new joining methods, is leading the nation in the use of adhesive bonding as a production method. The speaker is an acknowledged leader in the development of applications for adhesive bonding and is well known for his technical papers and other writing on the subject.

Chairman: **Charles B. Leape**, Manager, Chemical Applications, Materials Engineering Dept., Westinghouse Electric Corp.

Adhesive Bonding of Metals and Plastics—**George Epstein**, Research Engineer, North American Aviation, Inc.

Question and Discussion Period

Wednesday, May 19, 2:00 P.M.

Subject: Materials Management

With an increasing importance in materials knowledge, it becomes imperative that industry take proper steps to acquire, assimilate and distribute this information where it is most needed. The speaker has had the opportunity of setting-up materials departments in several diverse industries and, therefore, can make recommendations that can be widely followed.

Chairman: **Stuart S. Kingsbury**, Chief Materials & Processes Development Engineer, Piaseck, Helicopter Corp.

How To Set Up and Operate A Materials Department—**Dr. M. A. Williamson**, Director of Research, Burroughs Corp.

Question and Discussion Period

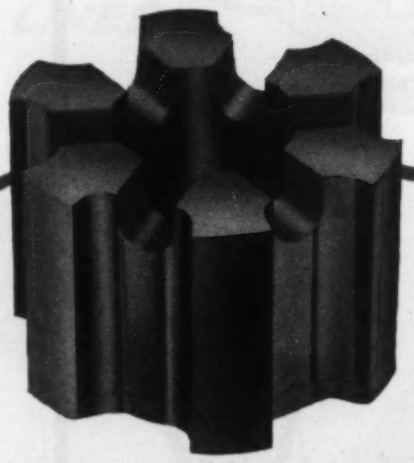
(Turn to page 141)

WATER IS THE ONLY LUBRICANT YOU

GRAPHITAR® BEARINGS

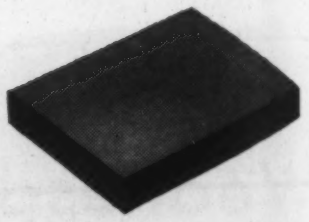
In various types of pumps and pump motors, rotary pressure joints, torque converters, turbines and similar applications where water or steam is present, GRAPHITAR makes a highly successful bearing material, because GRAPHITAR operates efficiently under heavy loads with water as the only lubricant. This is possible for two reasons: 1.) GRAPHITAR has a lower coefficient of friction than any other bearing material; and 2.) GRAPHITAR is porous and maintains an adequate water film at the bearing surface. In applications where the bearings are relatively inaccessible, the advantage is obvious, for GRAPHITAR eliminates bearing maintenance.

TIN LINE BEARING

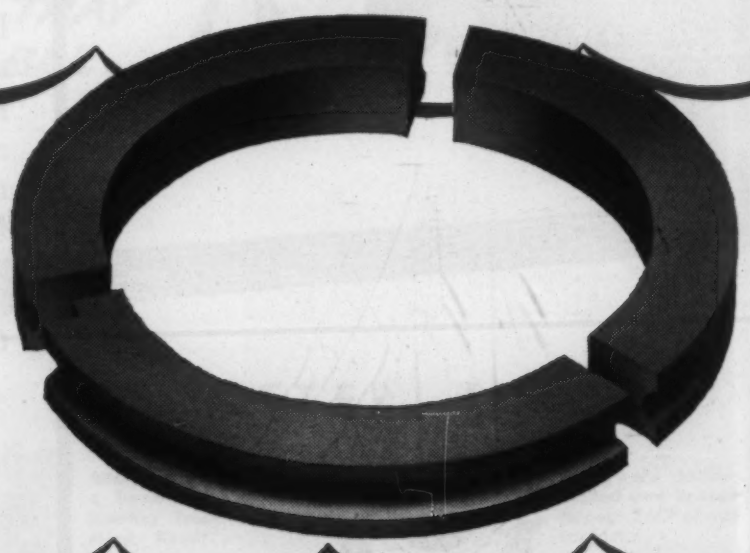


SLOTTED WATER PUMP BEARING

WATER PUMP VANE



STEAM TURBINE RING



THE UNITED STATES

OUR 100TH YEAR

Exhibitors

2nd Exposition of Basic Materials for Industry

Company	Booth No.
Albany Felt Co.	427
American Lava Corp.	340
American Silver Co., Inc.	229
Amos Molded Plastics Div. of Amos Thomas Corp.	418
Ampco Metal, Inc.	225
Balsa Ecuador Lumber Corp.	645
Beryllium Corp.	210
Bettinger Corp.	312
Brown Co.	345
A. M. Byers Co.	111
Carboloy Department of General Electric Co.	324
Carborundum Co.	325
Cerro de Pasco Corp.	318
Cold Metal Products Co.	707, 711
Corning Glass Works	216
Dobeckmun Co.	502
Dow Corning Corp.	329
E. I. du Pont de Nemours & Co., Inc.	200, 211
Ferroxcube Corp. of America	414
Firestone Plastics Co.	128
Frenchtown Porcelain Co.	235
Gamble Bros., Inc.	416
General American Transportation Corp.	328
General Plate Div., Metals and Controls Corp.	217
Globe Co.	415
Goodyear Tire & Rubber Co., Inc.	333
Haveg Corp.	342
Howard Foundry Co.	228, 232
Hunter Douglas Corp.	234
Improved Seamless Wire Co.	718
Industrial X-Ray Inc.	338
International Balsa Corp.	407
International Nickel Co.	341
Janney Cylinder Co.	125

Company	Booth No.
M. W. Kellogg Co.	320
LaSalle Steel Co.	240
Lignum-Vitae Products Corp.	407
Malayan Tin Bureau	131
MATERIALS & METHODS	311
Mica Insulator Co.	123
Mycalex Corp. of America	117
National Lead Co.	132, 134, 140
National Vulcanized Fibre Co.	241
Penton Publishing Co.	220
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Reinhold Book Div.	311
Reynolds Metals Co.	110
Rigidized Metals Corp.	135
Rohm & Haas Co.	233
South Florida Test Service	722
Sperry Products, Inc.	412
Star Porcelain Co.	235
Superior Steel Corp.	330
Superior Tube Co.	425
Sylvania Electric Products Inc.	120
Synthane Corp.	501
Taylor Fibre Co.	141
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Western Felt Works	215
Westinghouse Electric Corp.	406
Wisconsin Centrifugal Foundry, Inc.	724
Wolverine Tube Div.	602
Yale & Towne Mfg. Co., Powdered Metal Products Div.	133

The above list of exhibitors is correct as of press-time, April 12.

(Program continued on page 145)

*REO DESIGN ENGINEERS SAID...

TOUGH JOB?

WE'LL SPECIFY

STRESSPROOF®

SEVERELY COLD-WORKED, FURNACE-TREATED STEEL BARS

AGAIN!

*Reo Motors, Lansing, Mich., have again specified STRESSPROOF—this time for the power shaft on their new rotary lawn mower.

Another
Reo Lawn Mower
to Use STRESSPROOF

Reo engineers needed *top performance* from this new drive shaft . . . so they insisted on STRESSPROOF! They knew from years of successful experience with STRESSPROOF that it could take abuse. It had both the strength and wearability to stand up under the toughest service—and its excellent machinability was most welcome from a cost standpoint.

The alternative to STRESSPROOF would have been a heat-treated part, with the attendant cleaning, straightening, and machining problems.

Only STRESSPROOF gives you a unique combination of four qualities *in-the-bar:* Strength, Wearability, Machinability, and Minimum Warpage. Yet it costs less than the other quality cold-finished steel bars.

STRESSPROOF makes a better part at lower cost! It is available in cold-drawn or ground and polished finish.

SEND FOR . . .
Free Engineering Bulletin
"New Economies in the Use of Steel Bars"

La Salle STEEL CO.

Manufacturers of the Most Complete Line of Carbon and Alloy Cold-Finished and Ground and Polished Steel Bars in America.

La Salle Steel Co.
1418 150th Street
Hammond, Indiana

Please send me your STRESSPROOF Bulletin.

Name_____
Title_____
Company_____
Address_____
City_____ Zone____ State_____

For more information, turn to Reader Service Card, Circle No. 387

Description of Exhibits

Albany Felt Co. Booth No. 427

The purpose of the exhibit is to demonstrate that technical textiles are engineering materials. The exhibit consists of samples of industrial textiles, not only in flat cloths, but also in endless and tubular form, and fabricated parts. The samples are made from woven felt as well as most of the synthetic fibers.

The American Lava Corp. Booth No. 340

The display features custom-made technical ceramic parts grouped according to the chief constituent of the ceramic composition. Among these are parts made of compostions based on alumina of both dense and porous structure. In the display of AlSiMag titanate ceramics, hard, fine grained titanates used for thread guides, extrusion dies and wire recorder guides are available for inspection as well as titanates developed specifically for use as dielectrics for capacitors. Other AlSiMag parts on display are classified as Steatites, Lava, Silicon Carbide, Alumina, Cordierite, Zirconium Oxide, Zircon, Magnesium Silicate, Aluminum Silicate, Forsterite, and Titanium Dioxide.

American Silver Co., Inc. Booth No. 229

On display is a wide selection of ferrous, nonferrous and precious metal strip, including clad metal combinations, produced to close tolerances and ultra-thin gages. The exhibit features metal specimens, both in coil and fabricated form, and also murals depicting the company's special equipment. Advantages of using the high precision, thin gage metals are demonstrated from the angle of product improvement and miniaturization. A new line of thermostat metals is being shown as well as various industrial products fabricated from the company's precision metals.

Amos Molded Plastics Booth No. 418

Custom injection molders and finishers of thermoplastic molding materials, the company is exhibiting a variety of parts weighing up to 132 oz, molded in one piece with 1250 sq in. of projected area. Also molded parts are displayed with a variety of finishes, including vacuum plating, silk screening, reverse printing, roller coating, hot stamping, spray painting and wood graining.

Ampco Metal, Inc. Booth No. 225

The booth features a 3 ft "world" showing Ampco's distributors, licensee foundries, branch plants, etc., located throughout the world. Incorporated in the display are examples of centrifugal castings, sand castings, sheet and plate, arc and resistance welding products, stock bars, stock die blanks, solid and extruded rounds, shapes, pipe and tube, all manufactured by Ampco of Ampco Metal.

Balsa Ecuador Lumber Corp. Booth No. 645

The display demonstrates the properties, and stresses the applications of the company's Certified Kilndried Belcobalsa as a basic engineering material. Three general types of application are demonstrated: 1) as a core material for sandwich construction panels, flush doors, thick lumber core plywood, reinforced plastic parts, railroad cars and trailer panels and containers; 2) as a structural insulation material for cold storage rooms, containers, refrigerated cars and trailers; and 3) as a buoyant material for life saving equipment and sporting goods.

The Beryllium Corp. Booth No. 210

The Beryllium Corp. exhibit demonstrates the role of beryllium as a basic material by showing commercially available beryllium products and examples of their practical application. Beryllium metal, beryllium oxide and beryllium alloys are featured. The alloys include beryllium copper, beryllium in ferrous materials and beryllium in light metals.

The Bettinger Corp. Booth No. 312

The exhibit demonstrates the high temperature protection given to materials by ceramic coatings. The display consists of a 4-ft miniature J-47 jet engine, blown up photographs of the engine and various component parts, high temperature ceramic coated jet engine parts, and demonstrations of high temperature ceramic coated specimens. Also included is a high temperature furnace and smelter in which the protection afforded by ceramic coatings is demonstrated.

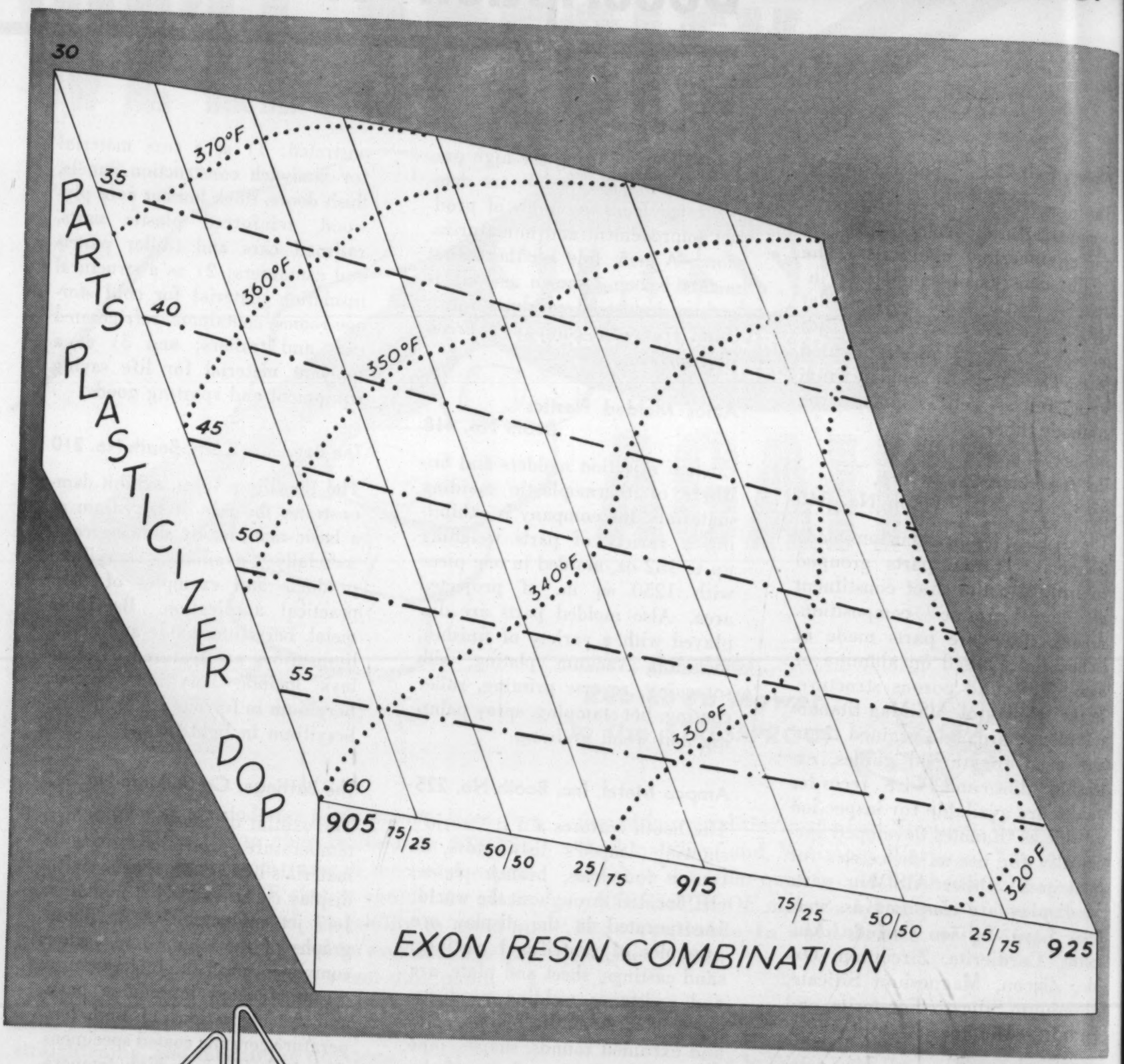
Brown Co. Booth No. 345

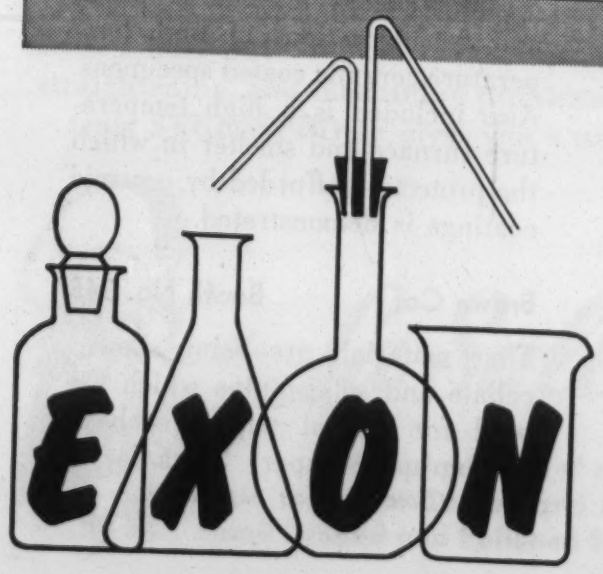
Four materials are being shown: cellate and solka pulps which are used for special papers such as photographic paper; Solka-floc, a

(Continued on page 148)

now Firestone helps you

CHART YOUR PROCESSING





Firestone Service charts your processing needs in 3 DIMENSIONS!

Consult this unique chart to determine the proper combination of Exon resins best suited to your processing conditions.

Follow the broken guide lines indicating Parts Plasticizer to the intersection of your Operating Temperature, indicated by dotted lines. Carry this point parallel to the solid black lines down to the Exon Resin Combination at the bottom of the graph.

G PROBLEM...AND SOLVE IT!

with Firestone's 3 new versatile, temperature-tailored resins

EXON 905–915–925

Operating temperature is virtually eliminated as a production problem by Firestone's 3 new EXON resins—905–915–925.

You need only determine your plasticizer loading and your operating temperature. Spot them on the chart at left—and you find the temperature-tailored resin or blend ideally suited to perform in your processing with excellent results.

These fast-fusing Exon resins offer you several inherent advantages. Among them are:

- Extremely rapid blending . . . hot or cold.
- Freedom from fisheyes . . . for higher quality, greater product uniformity.
- Shorter fusing time . . . assuring a faster, more economical operation.

For final adjustments to given processing conditions, a blend of one or more of the Exon resins may be used.

CHEMICAL PROGRESS WEEK-MAY 17-22

A BETTER AMERICA THROUGH CHEMICAL PROGRESS

Be sure to visit the Exon booth at the forthcoming shows:

SPE THE SIXTH national plastics exposition CLEVELAND JUNE 7-10 1954

Space 341

BASIC MATERIALS EXPOSITION

Space 128

PHYSICAL PROPERTIES

	FORM	SPECIFIC GRAVITY	AVERAGE RELATIVE VISCOSITY	AVERAGE BULKING DENSITY
EXON 905 Excellent for film and sheeting applications where higher temperatures (up to 375° F.) are called for.	White Powder	1.40	2.50	0.45
EXON 915 High-versatility, resin specially designed for sheeting. Wide range of operating temperatures.	White Powder	1.40	2.30	0.45
EXON 925 An excellent P. V. C. resin for low processing temperatures. (starting at 275° F.)	White Powder	1.40	2.05	0.45

For further information on Firestone's complete line of high quality EXON resins . . . or for the assistance of Firestone's Technical Service, call or write:

CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY • POTTSTOWN, PA., DEPT. 3A

Division of The Firestone Tire & Rubber Co.

For more information, turn to Reader Service Card, Circle No. 397

For Your Ferrous Casting Needs Get These...

4 Freedoms

Freedom from...

1 Porosity
2 High Cost Material
3 Expensive Machining
4 Metallurgical Variation

with

PERMANENT MOLD Gray Iron Castings

Permanent Mold Gray Iron Castings by DOSTAL offer many advantages. Their structure is uniform and surface scale is eliminated. These 2 factors permit higher speed machining with faster feeds. The dimensional accuracy and uniformity of DOSTAL Permanent Mold Castings reduces machining operations to a minimum. Permanent molded castings are uniform in hardness and their structure is dense and porous-free.

Write Us Now — Find out how you can cut the costs of your products through the use of Permanent Mold Gray Iron Castings.

DOSTAL

FOUNDRY and MACHINE COMPANY
2510 Williams Drive
Box 180 Pontiac, Mich.

For more information, Circle No. 393

Exhibits . . .

(continued from page 145)

fine cellulosic used as filter aid materials and also used as extenders for plastics and welding rod coatings; Nibroc papers used for backing abrasives, gum tape, masking tape, and in plastic laminates; and Onco used for insole material and as reeinforcing agent in bags, etc.

A. M. Byers Co. Booth No. 111

The growing use of wrought iron is the theme of this display. Included in the exhibit are: 1) samples of wrought iron in various product forms; 2) photographs of the metal in new and old services; 3) slides on wrought iron and the modern uses for which it is specified today; 4) literature describing applications which demonstrate durability and corrosion resistance properties; and 5) "The Vital Element Contest", in which visitors to the booth are invited to judge how many siliceous slag fibers are shown in a magnified photograph of a cross-section of wrought iron.

Carboloy Dept. of General Electric Co. Booth No. 324

The company's full line of created metals are on display: cemented carbides for cutting tools and wear applications; Alnico permanent magnets for electrical and mechanical applications; Hevimet for radio-active shielding and as a weight; and Thermistors for detection of minute temperature change. In addition to static displays, customer participation exhibits are used to show the uses and characteristics of these materials.

The Carborundum Co. Booth No. 325

Included in the booth are the various Carborundum materials: materials of construction, electric components, refractory hard metals—cermets, and chemicals. The newer forms and characteristics of Fiberfrax Ceramic Fiber are emphasized and portrayed through the use of translites and product samples. Also, other basic materials manufactured by the company such as aluminum oxide, silicon carbide and zirconium are displayed. Several new lines are being shown, such as refractory-hard cermets from Borolite as well as new products in seals and parts such as the glass sealing alloy of Kovar.

In animated displays a new range of resistors, heating elements and super refractories will round out the exhibit. The Carborundum subsidiaries and divisions represented in the booth are: American Tripoli Co., Bonded Products and Grain Div., Borolite Corp., The Carborundum Metals Co., Coated Products Div., Globar Div. and Stupakoff Ceramic and Manufacturing Co.

Cerro de Pasco Corp. Booth No. 318

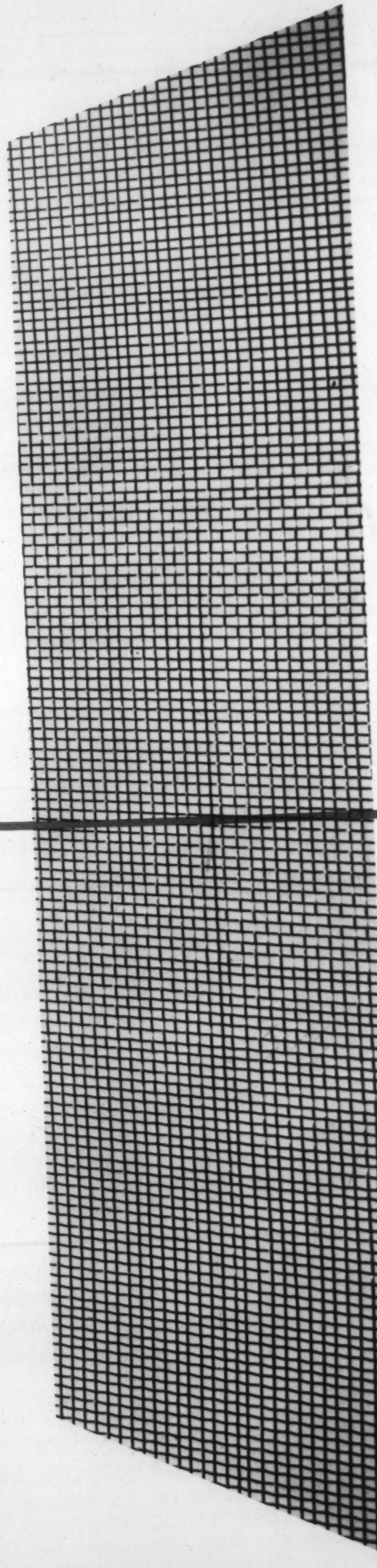
Being exhibited are the Cerro alloys (low temperature melting bismuth alloys). The raw components of the alloys are shown, together with the finished products. End products displayed include duplicate patterns, dies, safety devices, tube and mold bends, electroformed parts, pattern shop applications, etc., all of which have been fabricated with or by the use of various Cerro alloys. There are demonstrations of Cerroseal-35 the ultra-low melting temperature alloy which adheres to glass. Also shown are new and ingenious uses of the alloys in the pattern shop.

The Cold Metal Products Co. Booth Nos. 707, 711

The exhibit shows samples of precision cold rolled strip steel in low carbon, electro zinc coated, high carbon, stainless and tempered spring steel produced by the company and lists typical applications of each. A large illuminated colored illustration of the special

(Continued on page 156)

For more information, Circle No. 551



NO BARRIERS → *except imagination...*

SUPER REFRACTORIES

Trade Mark	Carbofrax®	Alfrax® K	Alfrax® BI	Mullfrax®	Monofrax®
Material	Silicon Carbide (over 85% SiC)	Electrically Fused Aluminum Oxide	Electrically Fused Aluminum Oxide	Electric Furnace Mullite	Fusion Cast High Alumina
Refractoriness—PCE	Cone 37 - 40	Cone 37 - 39	Cone 39 - 40	Cone 38 - 39	Crystalline No True PCE
Approximate Weight 9″ Str. Brick	9¼ lbs	10¼ lbs	4¾ lbs	9 lbs	10¼-11½ lbs
Heat Conductivity at 2200°F in BTU/hr, sq ft and °F/in. of thickness	109 BTU	24 BTU	7 BTU	16 BTU	23 - 31 BTU
Relative Resistance to Spalling	High	Good	Good	High	Low
Abrasion Resistance	High	High	Low	Good	High
Modulus of Rupture at 2460° F, psi	800-3125	100-1050	50-290	200-575	700-1800
Mean Coefficient of Thermal Expansion per °C, 25-1400 C	.0000047	.0000081	.0000086	.0000059	.0000084

Table shows the range of values for the different products normally manufactured under each classification.

POROUS MEDIA

Aloxite®	Permeability-Grades	Pore Size (avg. dia.)	Porosity	Modulus of Rupture	Density gms/cc	Refractoriness	Acid Resistance	Uniformity
aluminum oxide porous plates, tubes & disks	1-200	0.002″ to 0.100″	34% to 38%	500 to 3000 psi	2.2-2.3	900°C	Good	Excellent

ZIRCONIUM METAL

DENSITY
6.52 gms/cc at Room Temperature

MELTING POINT
1830 ± 40°C
3325 ± 70°F

ALLOTROPIC TRANSFORMATION:
863 ± 3°C
1585 ± 5°F

LINEAR COEFFICIENT OF THERMAL EXPANSION:
.0000052/°C at 20°C
.0000089/°C at 700°C

THERMAL CONDUCTIVITY:
¼ that of Iron

ELECTRICAL CONDUCTIVITY:
4.1% of Copper at 20°C

CORROSION RESISTANCE:

To alkalis: better than Ti, Tantalum, or 18-8 stainless.

To corrosive acids: extremely good except for HCl and concentrated H_2SO_4 and H_3PO_4.

To fused alkali and fused salts: excellent.

HOT ROLLED AND ANNEALED

Reduction in Area %: 30-40
Elongation %: 13-15
Yield strength 0.1% offset: 43,500 psi
Ultimate strength: 68,000-80,000 psi
Brinell Hardness: 140-160

CERAMIC FIBER

Fiberfrax® ceramic fiber is produced by air blasting a molten stream of aluminum oxide and silica melted in an electric furnace at 3300°F. The white, cotton-like mass consists of fibers ranging in diameter from 10 microns to less than 1 micron. All properties are retained up to 2300°F; will not melt under 3000°F. As blown, the fiber weighs 2 pounds per cu. ft. and can be compressed readily to a density of 12 pounds per cu. ft. with a pressure of 2 pounds per sq. in. 6 pounds per cu. ft. density, K factor based on me temperature is similar to that for rock and glass wo It also has exceptional electrical properties.

In addition to the bulk form, Fiberfrax fiber supplied as specialty papers, blocks, blankets, ma etc. Roving, yarn and woven fabric are near comp tion of development.

STUPAKOFF CERAMIC & MANUFACTURING CO. PRODUCTS

Ceramics

Stupakoff is a leading manufacturer of ceramic products for electrical and electronic applications for all voltages, frequencies and temperatures. Parts are made of Alumina, Cordierite, Forsterite, Magnesia, Porcelain, Zircite, Titanates, Stupalith and Steatite — plain, ground, metallized or assembled.

Stupalith

Where thermal shock conditions prevail, parts made of STUPALITH will withstand extremely severe service. Stupakoff makes parts ranging from a fraction of an ounce to several pounds in weight, in simple or intricate shapes, by pressing, extrusion, casting or ramming. Safely used at temperatures up to 2400° F.

Printed Circuits

By combining resistors and capacitors of precision values, in circuits designed in accordance with the requirements of individual applications, Stupakoff printed circuits save space and weight, speed assembly, reduce costs, minimize assembly errors. Sturdy, compact, accurate.

Kovar-Glass Seals

Perfectly closed and durable airtight assemblies are made with Stupakoff Kovar-Glass Seals. The use of hard glass for these seals provides the highest degree of protection against thermal shock and weathering.
Stupakoff Seals are available in a wide variety of standard sizes and designs, and are made in many special forms.

Kovar Metal & Parts

The ideal alloy for glass sealing, Kovar matches the expansivity of hard glass over the entire working temperature range. It resists mercury attack, and seals readily with simple oxidation procedure. Available as sheet, strip, foil, rod, tube, wire — or fabricated into cups, eyelets, leads and other shapes.

Metallized Ceramics

Stupakoff specializes in the application of metal to ceramic parts for a variety of purposes, such as terminals; ceramic capacitors; printed electronic circuits; printed wiring; strain insulators, terminal boards, lead-in insulators; metallized shafts; ceramic-metal seals.

Ceramic Dielectrics

For by-pass, lead-through blocking, standoffs and trimmer applications; also temperature-compensating Ceramic Dielectrics having coefficients from P-100 to N-2700, and high K materials up to K-6000. Made in the form of tubes, discs, and special shapes, plain or silvered.

Resistor Ceramics

Stupakoff Temperature - Sensitive Resistors are used for temperature indicating or measuring equipment such as Radiosonde, for infra-red light source and for heating elements. Supplied complete with terminals, in the form of rods, tubes, discs, bars, rings, etc.

Assemblies

Stupakoff assemblies include metallized Ceramic Induction COILS for radio receivers and transmitters; metallized ceramic SHAFTS for air-tuning condensers; METALLIZED PLATES for making fixed rigid assemblies; printed circuits; ceramic trimmer condensers; terminals; many other ceramic to metal products. High precision or commercial tolerances.

GLOBAR® DIVISION PRODUCTS

CERAMIC RESISTORS

Three basic types — for normal resistance in electrical or electronic circuits, for special applications involving temperature effects or time delay, for circuits requiring resistances which vary with voltage.

PREDOMINANT PROPERTIES	TYPE	NOMINAL CHARACTERISTICS: TEMPERATURE COEFFICIENT in %/°C@25°C	NOMINAL CHARACTERISTICS: VOLTAGE COEFFICIENT	NOMINAL CHARACTERISTICS: DISSIPATION CAPABILITY	TYPICAL APPLICATIONS
CONVENTIONAL	A	—.1%/°C or less	.1%/deg. C or less	NORMAL	D. C. and audio frequency circuits in hearing aids, radio and television, x-ray equipment, etc.
CONVENTIONAL	CX	+.1%/°C or less	negligible	EXCEPTIONAL	Radio frequency circuits such as antenna terminations and parasitic suppressors.
TEMPERATURE SENSITIVE	B	—.3% to —.55%/°C	relatively small but sometimes significant	NORMAL	Temperature compensation of instruments and control devices.
TEMPERATURE SENSITIVE	F	—.1% to —2.2%/°C	negligible	ABOVE NORMAL	Temperature compensation, time delay, and current limitation in starting electron tubes and other low power apparatus; temperature measurement and control.
TEMPERATURE SENSITIVE	H	—2.7% to —4.5%/°C	negligible	ABOVE NORMAL	Temperature compensation, time delay, and current limitation in starting electron tubes and other low power apparatus; temperature measurement and control.
VOLTAGE SENSITIVE	BNR	—.6%/°C or less	up to 4% change of R per 1% change applied V.	NORMAL	Surge limiting; voltage stabilization; D. C. control of A. C. resistance; volume compression; harmonic generation.

TURING CO. PRODUCTS

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Printed Circuits

By combining resistors and capacitors of precision values, in circuits designed in accordance with the requirements of individual applications, Stupakoff printed circuits save space and weight, speed assembly, reduce costs, minimize assembly errors. Sturdy, compact, accurate.

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Metallized Ceramics

Stupakoff specializes in the application of metal to ceramic parts for a variety of purposes, such as terminals; ceramic capacitors; printed electronic circuits; printed wiring; strain insulators, terminal boards, lead-in insulators; metallized shafts; ceramic-metal seals.

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Assemblies

Stupakoff assemblies include metallized Ceramic Induction COILS for radio receivers and transmitters; metallized ceramic SHAFTS for air-tuning condensers; METALLIZED PLATES for making fixed rigid assemblies; printed circuits; ceramic trimmer condensers; terminals; many other ceramic to metal products. High precision or commercial tolerances.

ERISTICS		
	DISSIPATION CAPABILITY	TYPICAL APPLICATIONS
	NORMAL	D. C. and audio frequency circuits in hearing aids, radio and television, x-ray equipment, etc.
	EXCEPTIONAL	Radio frequency circuits such as antenna terminations and parasitic suppressors.
	NORMAL	Temperature compensation of instruments and control devices.
	ABOVE NORMAL	Temperature compensation, time delay, and current limitation in starting electron tubes and other low power apparatus; temperature measurement and control.
	ABOVE NORMAL	
ge rge	NORMAL	Surge limiting; voltage stabilization; D. C. control of A. C. resistance; volume compression; harmonic generation.

REFRACTORY-HARD METALS

BOROLITE CORPORATION PRODUCTS

PRODUCT	Zirconium Borides	Chromium Borides	Molybdenum Nickel Borides	Nickel Aluminides
Essential Constituents	Zirconium & Boron	Chromium & Boron	Molybdenum, Nickel & Boron	Nickel & Aluminum
Density gms/cc	5.2 to 5.4	6.6 to 6.9	8.6	6.0
Melting Point	5400°F	2900°F - 3050°F	3500°F	3100°F
Hardness (Rockwell)	88-91 (A)	60-86 (A)	88-90 (A)	35-50 (C)
Electrical Resistivity 68°F Microhm - cm.	17	28 - 47	66 - 71	20 - 30
Transverse Rupture Strength - psi	68°F - 66,000 1800°F - 63,000 2200°F - 55,000	68°F - 88,000 to 125,000 1800°F - 88,000 to 125,000	68°F - up to 100,000	68°F - 144,000 1800°F - 70,000
Stress-to-Rupture psi @ 1800°F & 100 hours	18,500	10,000 to 15,000	—	—
Oxidation Resistance @ 2000°F (Weight gain in 200 hrs.)	15 mg/cm²	1.8 mg/cm²	Not Recommended for High Temperature Use	2.0 mg/cm²
Thermal Shock Test N.A.C.A. (100 Cycles & Terminal Temperature 2400°F)	No Failure	No Failure	Not Recommended for High Temperature Use	No Failure
Coefficient of Thermal Expansion (x 10^{-6})	@ 68°F - 2.5 @ 1800°F - 5.7	@1800°F - 5.8	—	@ 1800°F - 8.4

Mo-Braze molybdenum boride Brazing Compound is available in powder and rod forms. It is used for brazing molybdenum to molybdenum, tungsten to molybdenum and tungsten to tungsten.

CHEMICALS

Zirconium Oxide

A white pigment which, when mixed with silica, alumina, and other oxides is used in the petroleum industry as a catalyst for the cracking of hydrocarbons, the hydrogenation of motor fuels, the production of butadiene from alcohol, the oxidation of naphthalene to phthalic anhydride, and the production of synthetic ammonia. The hydrous oxide and carbonate are used to treat poison ivy and dermatitis, in antiperspirants and deodorants. The oxide is used as an opacifier in white and colored vitreous enamels and in the production of fine porcelain and ceramic bodies for the electrical and electronic industries.

Zirconium Tetrachloride

An anhydrous dry powder with a host of uses and potentialities. A catalyst in numerous reactions including the detergent, oil and fuel industries, a catalyst in the FRIEDEL-CRAFTS reaction, in the production of copper phthlocyanine. In the dye industry it is an excellent "laking" agent, a fixative for both acid and basic dyes. It is a raw material for other zirconium compounds—and the ortho-esters—new resin-like materials for the paint industry.

The applications are endless—limited only by our present knowledge.

Zirconium Carbonitride

A heavy massive golden "man-made mineral" containing up to 85% zirconium as the carbide and nitride. Reactive—pure—a deoxidizer in the metallurgical field—desulphurizer in the steel industry.

This is a cheap and pure and reactive source of zirconium. Can you use some?

Zirconium Oxychloride

A white, dry salt, extremely soluble in water and useful in the processes of waterproofing fabrics, a starting material for other zirconium chemicals, a clean starting material for the dye industry, a catalyst of untried merit.

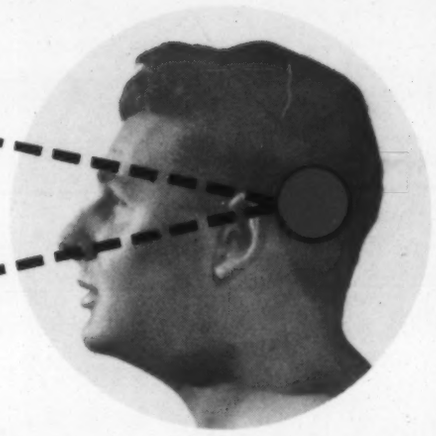
Magnesium Chloride-Anhydrous

Pure $MgCl_2$—one of the most powerful dehydrating agents—and a source for very pure magnesium salts. An excellent hydrating agent for insecticides and sprays.

Fused Salt

New! Different! Zirconium fused salt, 85-88% $ZrCl_4$—pure, clean, reactive. Used to refine Mg and Al castings and in the production of alloys. Large Mg castings are made possible by the use of fused salt.

We invite you
to use
your imagination
on how best
to use the
CARBORUNDUM
family of
Materials of Construction
Electronic Components
Refractory-Hard Metals
Chemicals



...all on display here
and at the
BASIC MATERIALS SHOW
Booth 325

CARB

THE CARBORUNDU

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temperature processe

SUBSIDIA

AMERICAN TRIPOLI
"Seneca Standard" T
parting, catalyst carr

BONDED PRODUCTS
Niagara Falls,
Grinding wheels, shar
iron and steel deoxidiz

BOROLITE CORPORA
High temperature bori

THE CARBORUNDUM
Zirconium, zirconium

COATED PRODUCTS D
Coated abrasive sheets,
attachments, adhesives

GLOBAR DIVISION, N
Ceramic resistors, non-
industrial electric furn

REFRACTORIES DIVIS
Super-refractories, (bric
media, catalyst suppor

STUPAKOFF CERAMI
Latrobe, Pa.
Ceramic and metallized
and electrical industrie
seals, metal-to-ceramic

Your request for
Research and Developmen
above, will rec

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CARBORUNDUM

REGISTERED TRADE MARK

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

• • • Specialists in electric furnace products and high temperature processes and materials, coatings, ceramics

SUBSIDIARIES AND DIVISIONS

AMERICAN TRIPOLI CORPORATION, Seneca, Mo.
"Seneca Standard" Tripoli for buffing and polishing compounds, foundry parting, catalyst carriers.

BONDED PRODUCTS AND GRAIN DIVISION, Niagara Falls, N. Y.
Grinding wheels, sharpening stones, polishing grain, tumbling nuggets, iron and steel deoxidizers.

BOROLITE CORPORATION, Niagara Falls, N. Y.
High temperature borides, aluminides and silicides.

THE CARBORUNDUM METALS COMPANY, INC., Akron, N. Y.
Zirconium, zirconium compounds and allied chemicals.

COATED PRODUCTS DIVISION, Niagara Falls, N. Y.
Coated abrasive sheets, belts, discs and rolls, grinding devices and attachments, adhesives and sealers.

GLOBAR DIVISION, Niagara Falls, N. Y.
Ceramic resistors, non-metallic heating elements for ceramic kilns and industrial electric furnaces.

REFRACTORIES DIVISION, Perth Amboy, N. J.
Super-refractories, (bricks, special shapes, cements), porous filters and diffuser media, catalyst supports, ceramic fibers.

STUPAKOFF CERAMIC AND MANUFACTURING COMPANY, Latrobe, Pa.
Ceramic and metallized-ceramic components and assemblies for the electronic and electrical industries, glass-sealing alloy metal and parts, metal-to-glass seals, metal-to-ceramic seals.

● Your request for technical information, addressed to the Research and Development Director of the appropriate group above, will receive prompt attention.

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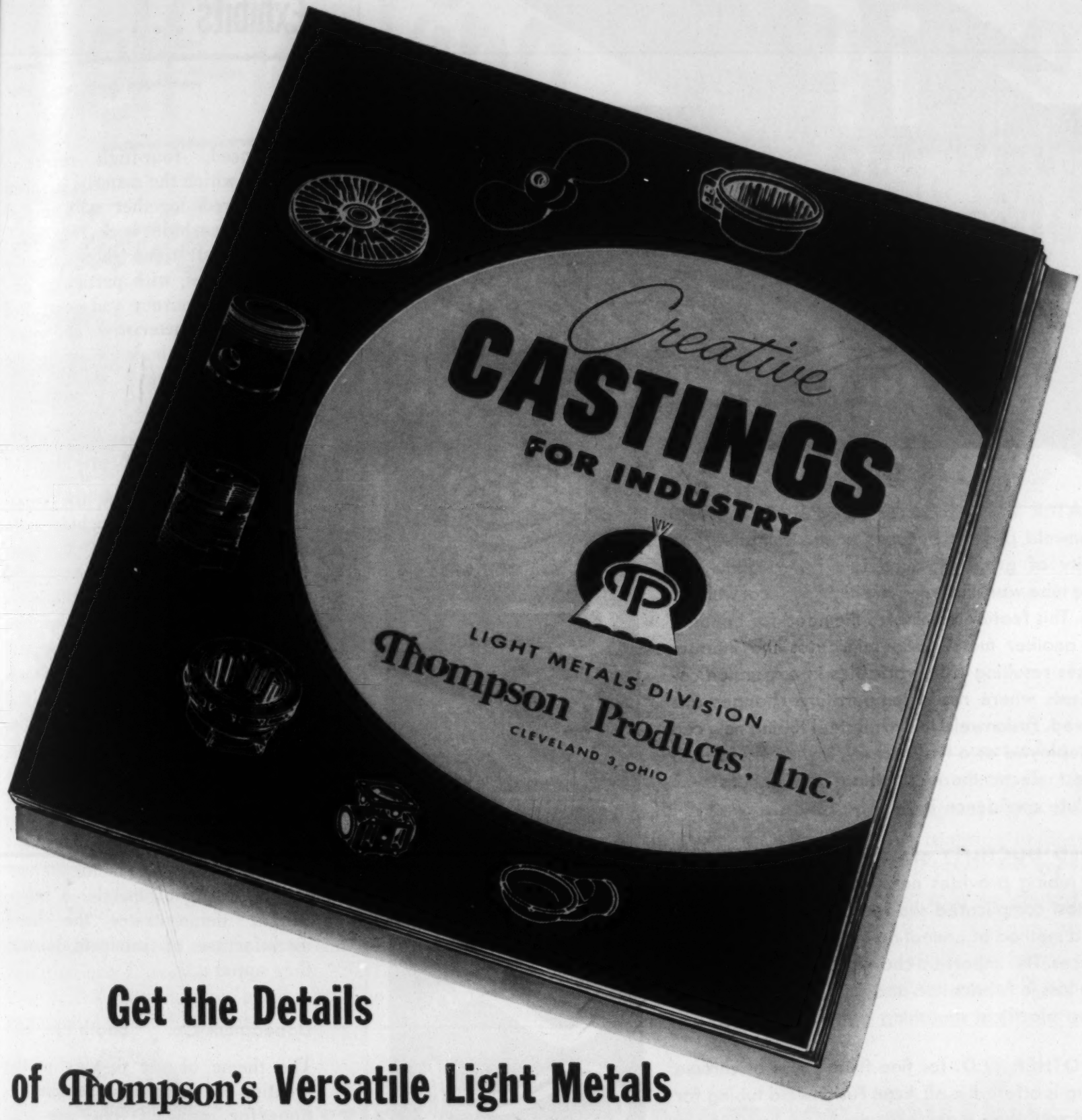

Get the Details of Thompson's Versatile Light Metals Casting Operation

IF you use castings, you'll want this booklet which describes the versatile foundry facilities available to you at Thompson Products' Light Metals Division.

Over 50 years experience in research and manufacture of precision metal parts enables Thompson today to offer its facilities to all types of industry.

This booklet details the entire light metals operation at Thompson and features some of the many parts precision-engineered by Thompson for such diversified customer uses as airplanes and washing machines; buses and garbage disposers; tractors and outboard motors; automobiles and industrial engines. It describes, too, some of the many research and manufacturing pluses used by Thompson to insure you of quality parts, delivered when you want them.

Fill in this coupon and mail today for your free copy:

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Please send me a copy of your booklet, "Creative Castings"

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Company_____

Address_____

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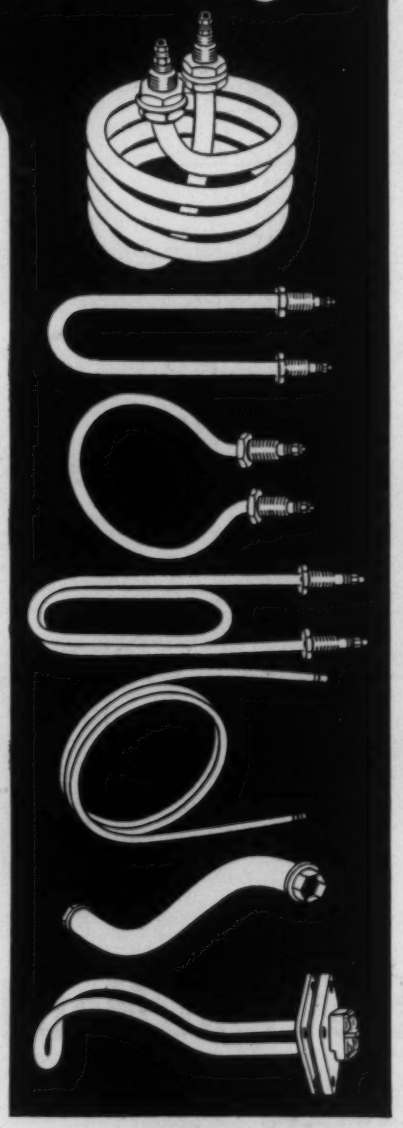
For more information, turn to Reader Service Card, Circle No. 342

if you use tubing . . .

USE AVON Fusionweld

for these *plus* advantages

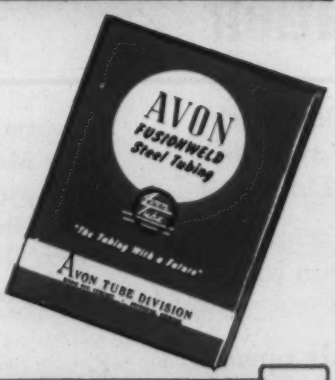


GREATER STRENGTH is offered by Avon's new Fusionweld process because of the complete uniformity of grain structure found throughout the entire tube wall, including the highly critical welded area. This feature eliminates the need for bonding with another metal, also eliminates the internal stresses resulting from variables in expansion coefficients where rapid temperature changes are involved. Fusionweld thin-wall steel tubing now can be employed as a satisfactory, low cost substitute in most electro-thermal tubing applications with absolute confidence in the end results.

ADDED DUCTILITY of Avon Fusionweld thin-wall steel tubing provides new ease of forming even the most complicated shapes due to our new controlled method of annealing in special atmospheric furnaces. This important characteristic insures lower scrap loss in fabrication and superior performance in most electrical sheathing applications.

SMOOTHER O.D. for fine finish brass or chrome plating is offered in all Avon Fusionweld tubing for electrical fixture manufacturers.

MORE ECONOMICAL—Avon Fusionweld guarantees a very definite price advantage coupled with greatly broadened usefulness and new savings which now can be affected in fabricating operations—with far greater freedom from scrap loss.



3/16" O.D. to 5/8" O.D. Plain or Terne Coated.
We can fabricate tubing to your requirements.

AVON TUBE DIVISION
HIGBIE MANUFACTURING CO.
ROCHESTER MICHIGAN

For more information, turn to Reader Service Card, Circle No. 367

Exhibits . . .

(continued from page 148)

high-speed, four-high reversing mill on which the material is rolled is featured together with actual tungsten carbide work rolls used. Other illustrations show production facilities, with particular emphasis on accuracy and control of physical characteristics, and quality control methods in use in the company's plants.

Corning Glass Works
Booth No. 216

The displays illustrate the versatility of glass. They include audience participation exhibits showing how glass transmits or absorbs various useful bands of the spectrum, withstands sudden temperature change, has excellent electric characteristics, possesses mechanical strength and resists corrosion.

New products include a radiation-absorbing window for atomic energy installations, lighting panels which control illumination, fused silica for ultra-sonic delay lines, an all-glass aperture mask for color television, and glass molds for precision casting of metals. A lampworker demonstrates the hand manufacture of intricate laboratory apparatus.

Dobeckmun Co. Booth No. 502

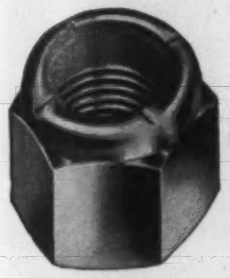
The theme of the display is the creation of new custom laminations for industry. The raw materials from which the final products shown are made include cellophane, cellulose acetate, Mylar (polyester film), aluminum foil and polyethylene and vinyl resins.

The products shown include: Doplex Brilliant, a lamination of transparent plastic film to fine paper stock with non-fading pigments added to the adhesive; Plasticolor, a laminated cover paper and clear acetate with colored adhesives; Dobar, a slot cell insulator for fractional and integral horsepower motors, phase insulation, layer insulation or phalanges; and various papers laminated with acetate or Mylar polyester films.

(Continued on page 158)

self-locking fasteners

Elastic Stop nuts

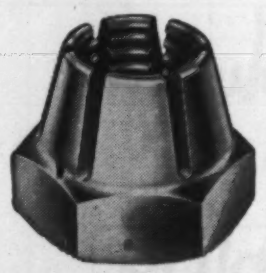


HEX NUT

SPLINE NUT

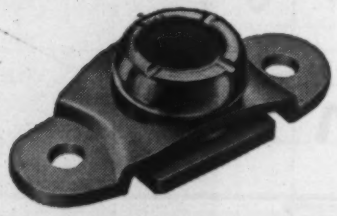
HIGH TENSILE NUT

CLINCH NUT



1200° F. HIGH-TEMP. NUT

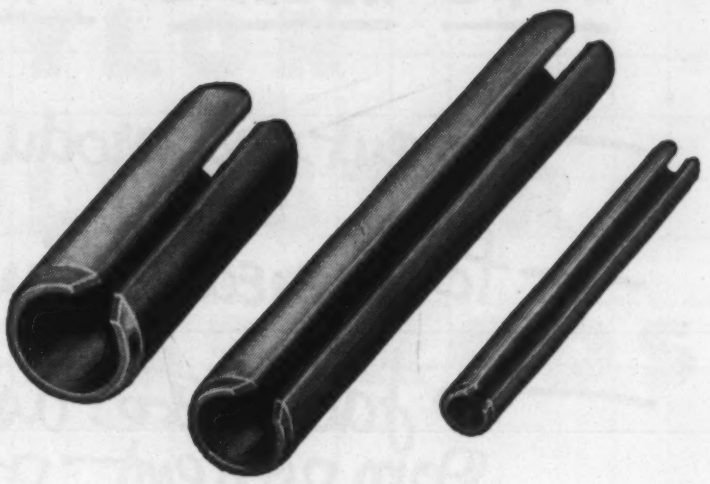
GANG CHANNEL NUTS



FLOATING ANCHOR NUT

Every major aircraft now being assembled relies on the vibration-proof holding power of ELASTIC STOP nuts. Only ESNA manufactures a complete line of all types and sizes of self-locking nuts.

Rollpins



dia. from 1/16" to 1/2"

Rollpins are slotted, tubular steel, pressed-fit pins with chamfered ends. They drive easily into holes drilled to normal tolerances, compressing as driven. Extra assembly steps like hole reaming or peening are eliminated. Rollpins *lock* in place, yet are readily removed with a punch and may be reused.

Cut assembly costs by using Rollpins as set screws, positioning dowels, clevis or hinge pins. Specify them in place of straight, serrated, tapered or cotter type pins.

ELASTIC STOP NUT CORPORATION OF AMERICA

ROLLPIN TRADEMARK

Mail Coupon for Design information

Elastic Stop Nut Corporation of America
Dept. N 34-561, 2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

- ☐ Elastic Stop Nut Bulletin
- ☐ Rollpin Bulletin
- ☐ AN-ESNA Conversion Chart
- ☐ Here is a drawing of our product. What fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone___ State_____

• For more information, turn to Reader Service Card, Circle No. 411

See How C.M.P.
can engineer specifications
for precision
COLD ROLLED STRIP STEEL
— to extend product costs.
— to increase yield.
— to facilitate assembly of component parts.
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— to improve product appearance.
Without Capital Investment!
at Booths 707 and 711 (NORTH HALL)
Basic Materials Show —
International Amphitheatre,
Chicago, Ill.,

the Cold Metal Products co.

GENERAL OFFICE: YOUNGSTOWN 1, OHIO
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LOW CARBON, HIGH CARBON (Annealed or Tempered), STAINLESS AND ALLOY GRADES, ELECTRO ZINC COATED ARE AVAILABLE FROM:
THE COLD METAL PRODUCTS CO. OF CALIFORNIA
6600 McKinley Avenue, Los Angeles Phone: PLeasant 3-1291
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PRECISION STEEL WAREHOUSE, INC.
4425 W. Kinzie, Chicago Phone : COlumbus 1-2700

For more information, turn to Reader Service Card, Circle No. 531

Exhibits . . .

(continued from page 156)

Also included are many types of paper or cloth fabrics to which polyethylene or vinyl coatings have been applied for such uses as heat and light reflecting insulation, awnings, tents, protective clothing, liners, industrial papers, and heat-resistant table tops.

Dow Corning Corp. Booth No. 329

This booth displays typical examples of industrial applications of Dow Corning silicone products. For example, silicone resins are shown as insulating materials for electrical equipment; Silastic, Dow Cornings's silicone rubber, is shown as part of many electrical and mechanical devices; and silicone grease is demonstrated as a lubricant for permanently sealed bearings. Cutaways, moving demonstrations and photographs show in detail these and many more silicone applications.

In addition, new silicone products with unusual properties and many potential uses will be displayed including foamed silicone resins, air drying silicone rubber, and silicone molding compounds.

E. I. du Pont de Nemours & Co. Booth Nos. 200, 211

On display are basic materials for industry in the form of plastics and elastomers. These include nylon, Teflon and polyethylene, acrylic resins and chlorosulfonated polyethylene, an elastomer.

Ferroxcube Corp. of America Booth No. 414

Featured in this exhibit are applications of Magnadur, the new ceramic magnetic material developed originally by the Philips organization in Holland. The display is designed to show where it fits in the field of magnetic materials.

Firestone Plastics Co. Booth No. 128

The exhibit features Firestone

Here's good news for your product . . .

TAYLOR POLYESTER GLASS RODS

An unusual material developed by Taylor—polyester glass rods in natural, white, black and ten attractive colors—offers unlimited possibilities in many of the products you manufacture. For the first time, you can have a glass-reinforced plastic that is uniformly colored all the way through. Drill it . . . cut it . . . grind it . . . you'll see no fibrous appearance of glass filaments.

Although this new material weighs only one-fifth as much, it possesses flexural and tensile strength equal to that of low carbon steel. It's non-corrosive, and resists deformation from bending. Picture how you can use its color for decoration, identification, or coding . . . its high strength-to-weight ratio for structural parts . . . its excellent electrical properties in shafts for electronic components.

Taylor specialists will be glad to talk over the ways you can put this material to work. They'll be glad to discuss, too, the improvements in production and product quality that you can realize through the use of Taylor Vulcanized Fibre and Taylor Melamine, Phenolic and Silicone Laminates.

Colors available in production quantities include:

Natural . . . white . . . yellow (two shades) **. . . buff . . . orange . . . pastel red . . . red . . . dark red . . . brown . . . green . . . blue . . . black.**

SPECIFICATIONS: GPG Rod

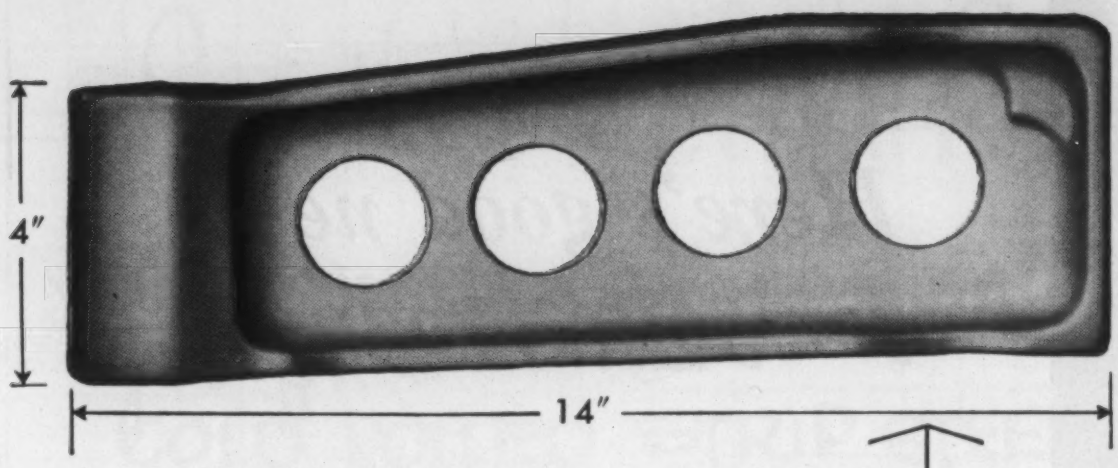
Flexural strength	65,000—85,000 psi.
Compressive strength (radial)	950—1,100 psi.
Arc resistance	120 sec.
Water absorption	0.10—0.20%
Resin content	50%
Specific gravity	1.60
Standard diameter	⅛" to ½"
Standard lengths	24" to 84"

Also available Chalk-Filled (GPG-C) and Flame-Retardant (GPF). Inquiries invited for larger diameters, longer lengths and special shapes.

TAYLOR FIBRE CO.
Norristown, Pa.—La Verne, Calif.

TAYLOR
Laminated Plastics
Vulcanized Fibre

For more information, turn to Reader Service Card, Circle No. 459



From Jet Bomber Parts
to Gas Range Burners

MUELLER BRASS CO.

Aluminum Forgings Save
Weight, Save Finishing Time
and Provide the
Strength as Steel

If weight and strength are important factors in your product, then Mueller Brass Co. forged aluminum parts may be your best bet. Mueller aluminum forgings weigh only 1/3 as much as steel, yet they are approximately as strong. They make ideal parts for many applications and they are particularly desirable as parts for high speed rotating and oscillating machines because they reduce vibration and bearing loads, thus causing less wear on other parts. They possess good dimensional stability and retain their mechanical properties at high speeds and reasonable temperatures. The smooth, bright surfaces save machining time and eliminate costly finishing. Mueller Brass Co. can forge aluminum parts to your specifications in any practical size and shape from any of the standard or special alloys. Write us today for complete information.

MUELLER BRASS CO.
PORT HURON 16, MICHIGAN

91-R

For more information, turn to Reader Service Card, Circle No. 513

Exhibits . . .

(continued from page 158)

Exon resins and has samples of various products made by users of Exon. Of particular interest are the examples of products made of unplasticized PVC for which Exon 402A is used as the basic resin. These include piping, injection molded fittings, fans, pumps, tanks, valves, ducts and other items used where resistance to corrosion is essential. Firestone Butaprene PL-1 paint latex is also shown.

Use of Exon is dramatized in several ways. A liquid circulating system is demonstrated with newly developed fittings and pump formed by injection molding. Products are also shown which illustrate the adaptability of Exon coatings to metals, fabrics, papers and electrical equipment.

Frenchtown Porcelain Co. **Booth No. 235**

On display are hundreds of different shapes and sizes of ceramic parts together with complete data on the many formulas the company can produce. Special applications of high alumina ceramic held to very close tolerances are shown.

Also featured are samples of Aluminox material, a high grade alumina ceramic, and wear-resistant mechanical Thermol with high dielectric properties.

Gamble Bros., Inc. Booth No. 416

Featured in the booth are flat sheet and shaped stock available in Gam-En-Wood, which is wood bound to various materials such as Enrup, rubber, metals and Formica. The combination of materials lends to wood heretofore unavailable resistance to abrasion, corrosion and heat, coupled with high dielectric properties in some combinations. The material is displayed as both resilient and stable.

Also shown are engineered wood products of various types.

General American Transportation Corp. **Booth No. 328**

Demonstrated in this booth is the

New Harvey aluminum alloy 66S will reduce your costs

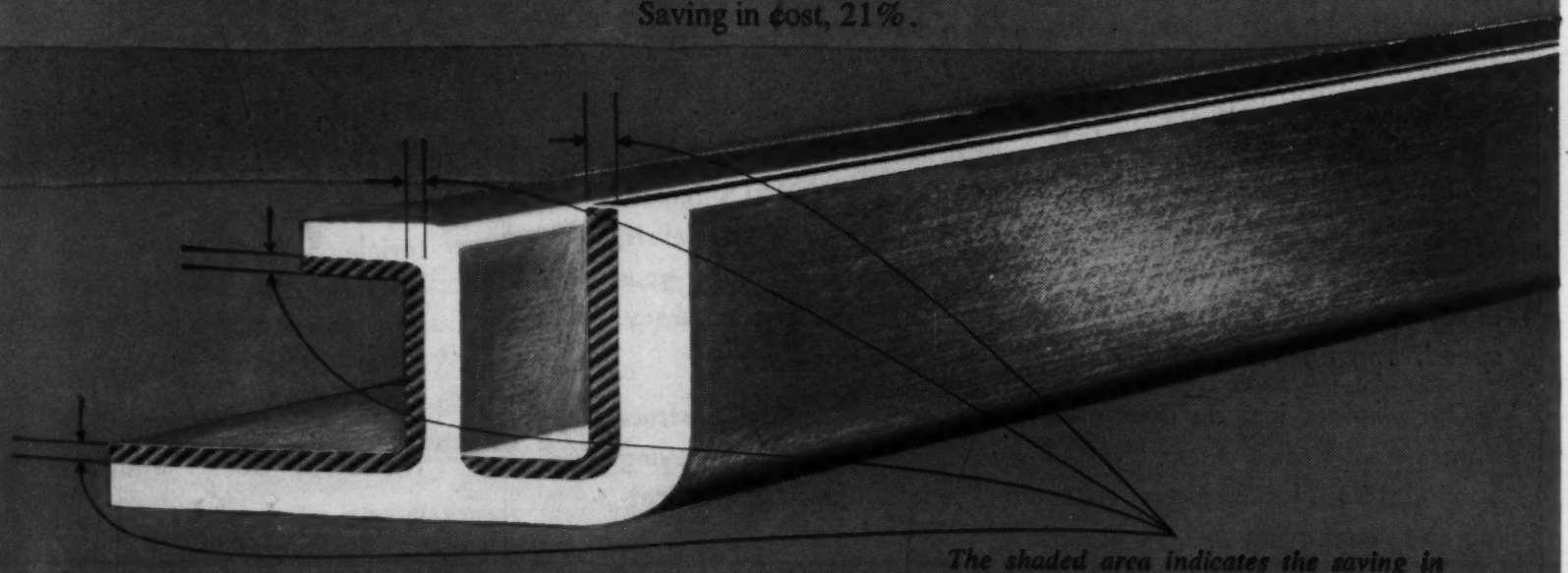
high-strength-low-cost-ratio

means that Harvey metallurgists have combined the essential qualities of many ideal structural alloys into a single new aluminum alloy—66S. This general purpose alloy is bringing real economy to many industries. It combines the high strength of 24S and the good corrosion resistance, weldability and economy of 61S.

Alert aluminum fabricators can now use 66S to reduce material costs, cut weight without sacrificing strength, and lower fabricating costs. You can reduce your costs at Harvey Aluminum... tooling service charges are nominal, and Harvey prepays the freight to your dock. Send for your Bulletin on 66S today.

here's how you save

The high yield strength of 66S permits you to reduce the cross section of structural members. This means real dollar savings in material costs. The extrusion below was made of 61S. By using the high yield strength of 66S its cross section is reduced as shown. The saving in material amounts to approximately 26%. Saving in cost, 21%.



The shaded area indicates the saving in material made possible by using 66S.

MAKING THE MOST OF ALUMINUM—FOR EVERYONE

HARVEY Aluminum

HARVEY ALUMINUM SALES, INC.
TORRANCE—LOS ANGELES, CALIFORNIA
BRANCH OFFICES IN PRINCIPAL CITIES

The men at Harvey Aluminum are dedicated to the idea of improving your product while reducing your costs. And remember, we prepay the freight to your plant.

An independent producer of aluminum extrusions in all alloys and all sizes; special extrusions, press forgings, bar stock, forging stock, tubes, impact extrusions, aluminum screw machine products and related products.

• For more information, turn to Reader Service Card, Circle No. 316

SINKO is now molding KEL-F

This remarkable new plastic material is now widely used in atom bomb and armament production — also has many important applications in the manufacture of industrial and civilian goods.

KEL-F offers advantages not found in many other plastic materials, among them:

√ Chemical Inertness—resistance to strong acids, oxidizing materials, and organic solvents.

√ Electrical Resistance—superior insulating properties, a poor conductor of heat.

√ Zero Moisture Absorption—resists moisture, unaffected by high humidity or tropical exposure.

√ Wide Temperature Range—has satisfactory properties from —320 F. to 390 F.

SINKO MOLDS ALL THERMOPLASTIC MATERIALS including Nylon, in sizes up to 60 oz. A highly skilled staff of specialists, using the latest in modern equipment, will manufacture your injection molded parts and products with the utmost in accuracy, speed, and economy.

Our services include Design and Engineering; Mold Construction; Metal-Plastic Assemblies; 2 and 3 color Plastic Spraying and Painting; Hot Stamping; Vacuum Distillation Plating; Fabricating and Assembling.

√ **Check with us now on your KEL-F and other Plastic Molding applications!**

Sinko

SINKO MFG. & TOOL CO.
3135 WEST GRAND AVE. • CHICAGO 22, ILLINOIS

BRANCH OFFICES:

HADDONFIELD, N. J.
TOM MUCKENFUSS—261 Wayne St.

DETROIT 2, MICH.
INLAND SALES CO—512 Stephenson Bldg.

MILWAUKEE 3, WIS.
RICHARD P. VALLEE—2302 W. Clybourn St.

DAVENPORT, IOWA
WIILLIAM R. VOSS—3818 Johnson Ave.

LOS ANGELES 23, CAL.
LITTRELL HARDWARES SALES CO—654 S. Anderson St.

For more information, turn to Reader Service Card, Circle No. 423

Exhibits . . .

(continued from page 160)

Kanigen Process for electroless deposition of nickel. The Kanigen Process is a method for producing an extremely uniform, hard, corrosion resistant coating of nickel on iron, steel, copper, brass, bronze and aluminum. The process readily permits plating on involved contours, screw threads, internal projections, or on very large parts.

General Plate Div., Metals & Controls Corp. Booth No. 217

A wide variety of composite metals are being featured with particular emphasis placed on composite base metals. Some typical combinations are Alcuplate, copper-clad aluminum; Nifer, nickel-clad steel; stainless steel-clad copper; Bronco, phosphor bronze-clad copper; and many others. Also shown are precious metals such as silver, gold, platinum and their alloys in the form of sheet, wire and tubing, as well as precious-clad base metals in sheet, wire and tubing.

Typical parts produced from Truflex thermostat metals are shown and some electrical contacts produced from precious-clad base metals along with their related materials. Several 1000-lb coils illustrate the long, continuous lengths of composite base metals available to industry.

The Globe Co. Booth No. 415

Displayed in their booth is the company's Grip-Strut material, for structural and industrial applications. Panels of both aluminum and steel, serrated in varying patterns for safety in flooring applications, for light-weight structural applications, or for decorative uses are shown.

Goodyear Tire & Rubber Co., Inc. Booth No. 333

Plastic Products, their design, processing, fabrication and possible uses are featured by Goodyear. PlioTuf, a new styrene resin,

Case History M M-110

Here's what we mean by *SUPERIOR* ENGINEERED FOUNDRY PRODUCTS...

PROBLEM:

1. This part for an assembly line conveyor was not being produced economically as a weldment.
2. The part must withstand constant shock and rough handling of the upper hinge member.

SOLUTION:

The proven principles of SUPERIOR ENGINEERED FOUNDRY DESIGN were applied in redesigning the part instead of merely duplicating the original weldment design as a steel casting. Machining of the part was done by Superior's machine shop.

RESULT:

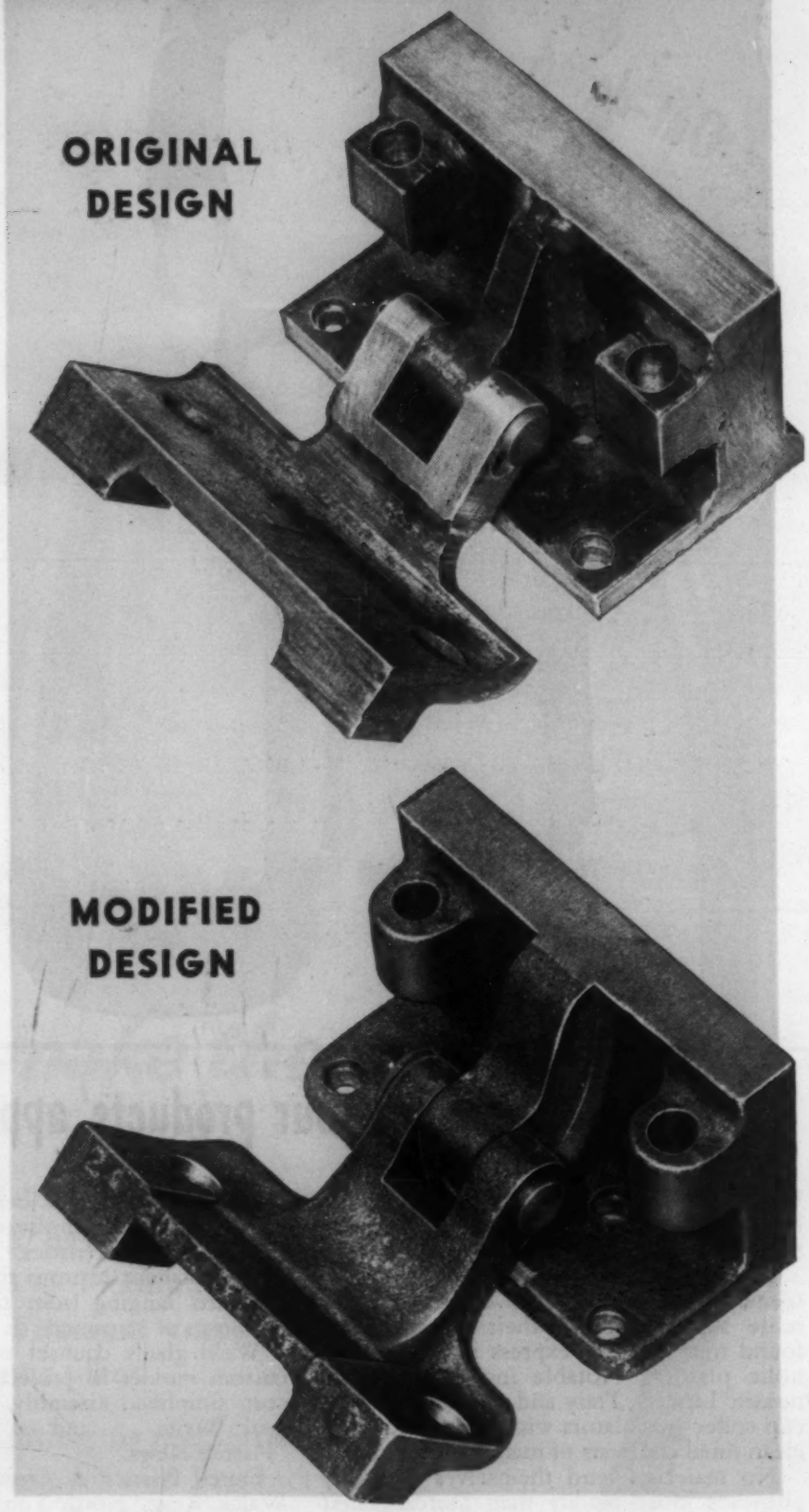
50.2% SAVINGS

1. The steel casting costs less to produce and less machining is required because the hinge pin hole is cored. Superior delivers complete, machined units, ready for installation.
2. The part has the steel casting's inherent strength for continuous hard use plus a weight reduction of 7.2%.

Total Cost of Part Reduced 50.2%.

YOU, TOO, CAN GET SAVINGS LIKE THESE BY CONSULTING SUPERIOR'S PRODUCT DEVELOPMENT SERVICE.

Remember...you benefit through correct design. If it can be cast, Superior's service develops the best design in which to cast it. If it shouldn't be cast, Superior's service develops the reasons why.



Courtesy of Fabricated Steel Products of Indiana, Inc.

Make your parts Superior Engineered Foundry Products . . . steel castings to 30,000 pounds . . . malleable iron castings to 300 pounds.

Have you entered the first annual Product Development Contest sponsored by the Steel Founders Society of America? We'll be happy to send you details. Just drop us a line.

SALES OFFICES:
CHICAGO 4, Railroad & Industrial Products Co., 332 S. Mich. Ave.
DETROIT 7, Sales Engineering Corporation, 955 E. Jefferson Ave.
BUFFALO 21, Gibney-Coffman Corporation, 2107 Kensington Ave.
CLEVELAND 14, C. A. Lapp & Co., 1404 East 9th Street

ENGINEERED FOUNDRY PRODUCTS

SUPERIOR STEEL AND MALLEABLE CASTINGS CO.

BENTON HARBOR, MICHIGAN, U.S.A.

Making Good Castings for Quality-Conscious People Since 1916

For more information, turn to Reader Service Card, Circle No. 410

Want to perk up your products' appeal?

USE MODERN MATERIALS to make them better fitted for success in this new competitive period.

Thousands of products that only recently seemed incapable of improvement are today more salable because their manufacturers found new ideas to express in Durez phenolic plastics. Notable instances are the newest Landers, Frary and Clark 8- and 10-cup coffee percolators with their handsome, clean-lined contrasts of metal and plastic.

No materials lend themselves to many purposes more readily than Durez. Their catalog of properties includes outstanding resistance to heat, moisture, and chemicals. Electrical characteristics, easy moldability, and permanent lustrous finish are available for parts ranging from pea-size to single moldings of 35 pounds or more each.

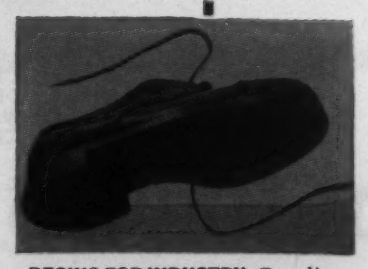
We'll gladly counsel with you or your custom molder in projects aimed at lower cost, simplified assembly, and new buy-appeal. Write . . . and ask for our monthly "Plastics News."

Durez Plastics & Chemicals, Inc., 1405 Walck Road, North Tonawanda, N. Y.

DUREZ

PHENOLIC PLASTICS

for the new Competitive Era



MOLDING COMPOUNDS. Structural, electrical, and chemical properties in many combinations.

RESINS FOR INDUSTRY. Bonding, casting, coating, laminating, impregnating, and shell molding.

Exhibits . . .

(continued from page 162)

one of the toughest commercially available plastics is demonstrated from powder and granule to finished consumer items.

A variety of uses and the outstanding features of Pliovic polyvinyl resins are shown primarily with novel end-products. Pliobond, the all-purpose adhesive, is also displayed with emphasis on how design and production problems can be solved with an adhesive.

Haveg Corp. Booth No. 342

Manufacturers of all types of corrosion resistant equipment for chemical, metallurgical, textile and food products industries, the company is exhibiting samples of the basic materials from which their products are made as well as many small items made of these materials.

Howard Foundry Company Booth Nos. 228, 232

Displayed are experimental titanium parts cast by a new process. Other materials featured are beryllium copper, ductile iron, high temperature ZT1 magnesium alloy, as well as aluminum, stainless steel, bronze, copper, nickel-iron cast alloys, and ductile iron bar stock.

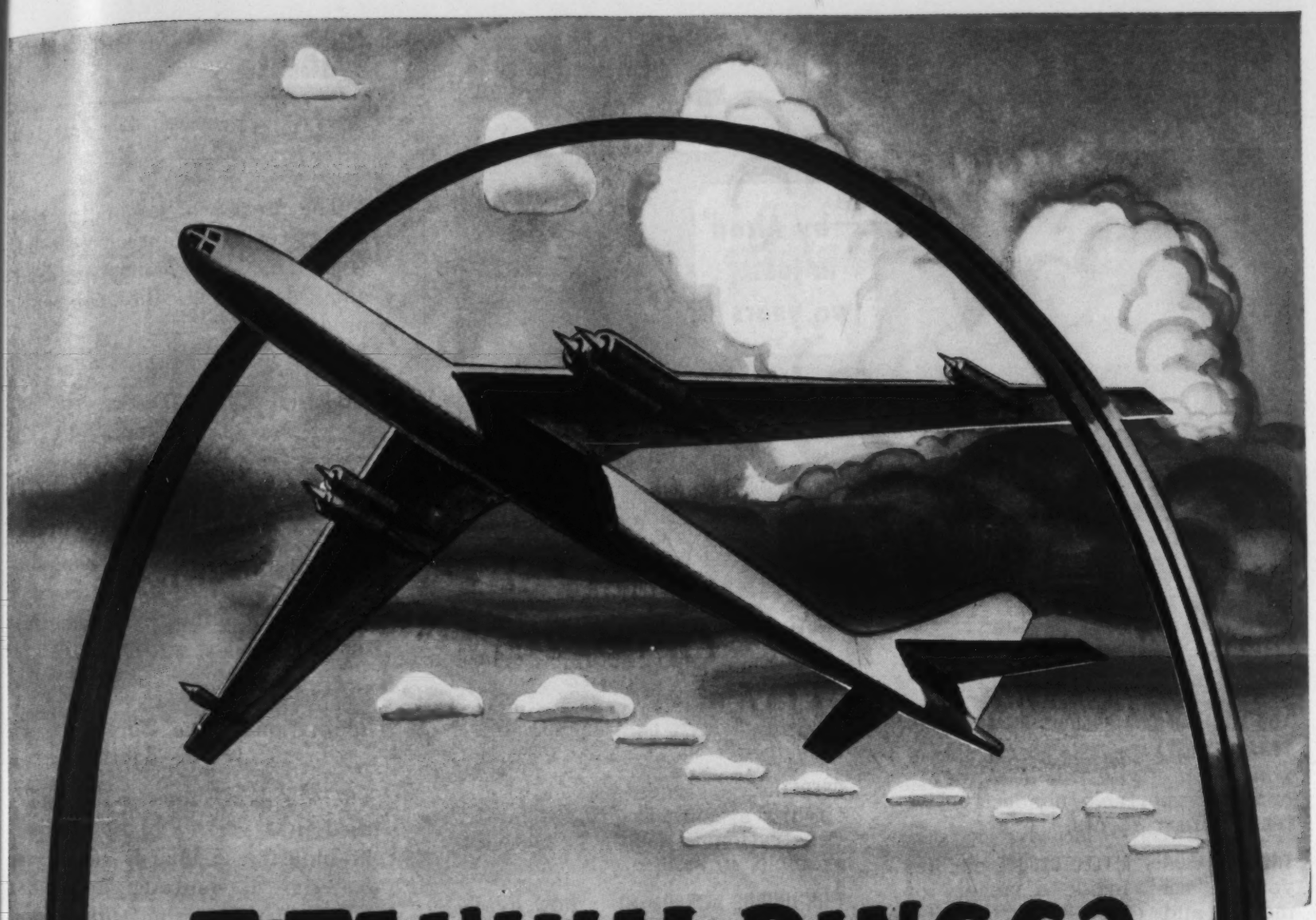
Actual sand core assembly (duplicated in dental plaster) shows step-by-step production casting techniques, and permanent mold and "lost wax" precision investment casting are demonstrated. Wood and metal pattern equipment for sand molding is also shown.

The Improved Seamless Wire Co. Booth No. 718

Featured in the booth are laminated materials, such as inlay and overlay sheet stock, and wire and tubing for the industrial and electronic field. Gold filled and rolled gold plate for the jewelry and optical industry is also being shown.

(Continued on page 166)

For more information, turn to Reader Service Card, Circle No. 409



TITANIUM RINGS?

... sure we make them

In 1950 American Welding completed the first successful production flash butt-welding of the new wonder metal — Titanium Alloy. Since that time hundreds of Titanium components have been produced in our plant.

If you use, or are planning to use, fabricated Titanium components, let our Product Development Division study your problem. Our factory is equipped to perform welding, machining, and fabricating of all types of ferrous and non-ferrous metals.
Call or write us today!

THE AMERICAN WELDING & MANUFACTURING COMPANY • 300 DIETZ ROAD WARREN • OHIO

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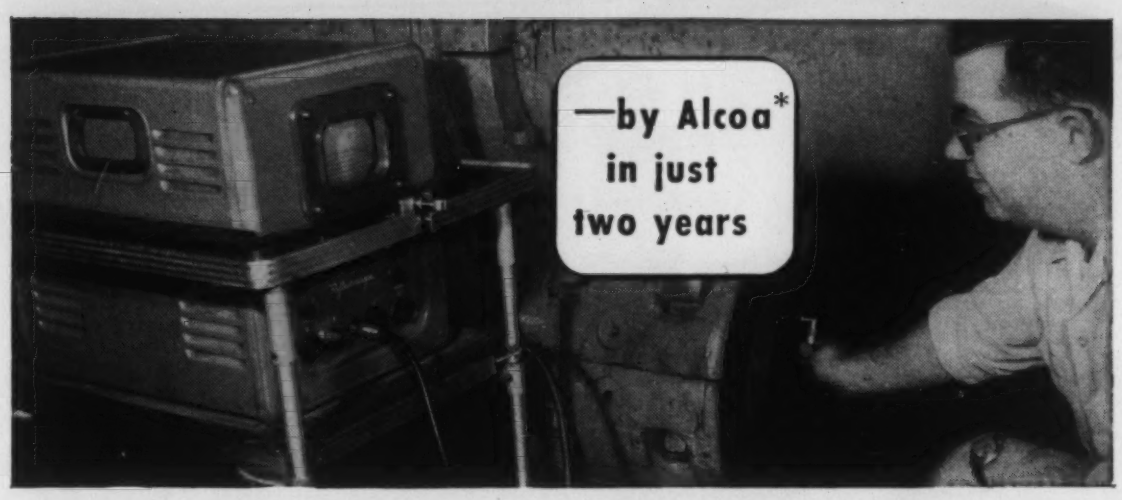
$1,000,000 SAVED



with the Sperry ultrasonic testing REFLECTOSCOPE

YOU TOO CAN CUT PRODUCTION AND MAINTENANCE COSTS — *whatever the size of your plant* — with this latest development in portable, nondestructive testing instruments.

THE ULTRASONIC REFLECTOSCOPE enables you to "see" inside a variety of metals and other materials. By means of a distinct pattern on a cathode ray tube, it enables you to locate and evaluate — *quickly, economically* — both surface and internal defects.

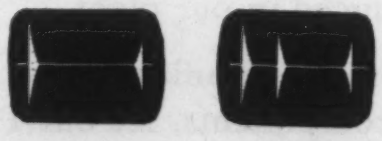
APPLICATIONS are unlimited. You can cut wasted machine- and man-hours through *fast, accurate quality-control* of raw materials and machined parts. You can eliminate serious production delays through discovering fatigue cracks in your heavy equipment *before they lead to breakdown.*

OPERATION is simple — all electronic circuits are practically automatic. Penetration is deep — 30 feet, for example, in solid steel.

THIS UNIQUE INSTRUMENT is now available to you through: (1) direct purchase, (2) lease for any period from two months up, or (3) "commercial testing" (we'll send a Sperry Inspection Engineer with Reflectoscope right to your plant, or test in our own laboratories materials you ship us).

OUR NEW BULLETIN 50-105 tells the whole story . . . just *how, where* and *why* the Ultrasonic Testing Reflectoscope can cut your costs from raw materials to finished product. To get your copy immediately, fill out and mail the attached coupon today.

* "We have had over two years experience in nondestructive testing with the Sperry Ultrasonic Reflectoscope. It has been used for the regular inspection of all our extrusion presses. Some 19 press columns have been removed before failure on data provided by the Reflectoscopes. The resultant savings in press damage and down time are estimated to exceed well over $1,000,000."
— Aluminum Company of America



TYPICAL TEST PATTERNS on Reflectoscope screen. At left, material O.K. At right, center "reflection" indicates and locates defect.

SPERRY PRODUCTS, INC.
Leader Since 1928
in Nondestructive Testing

Sperry Products, Inc.
400 Shelter Rock Road
Danbury, Connecticut

☐ Please send me a copy of your new Bulletin 50-105.

☐ Have your representative call.

Material to be tested.....
Name.....
Title.....
Company.....
Address.....
City.....Zone.....State.....

For more information, turn to Reader Service Card, Circle No. 386

Exhibits . . .

(continued from page 164)

The process of laminating gold and silver to non-precious metals is explained, and leaflets are available describing the company's products.

Industrial X-Ray Inc.
Booth No. 338

Featured in the booth is a visual demonstration of the industrial uses of radiography as a means of improving quality, increasing production, and reducing costs of products. Literature and case history material is also available.

International Balsa Corp.
Booth No. 407

The display shows balsa wood used in a variety of applications in industry, primarily as a core material in sandwich and other types of construction with plastic, metals and in plywood. Also shown is its use as insulation.

The basic properties of lightness, strength, resiliency, easy workability and durability are demonstrated.

International Nickel Co.
Booth No. 341

The company demonstrates in their booth the properties and qualities of ductile iron. Visitors are invited to use the "twist and bend" machine to prove to themselves the unusual combination of mechanical properties of the material.

An ultrasonic tool, made with nickel and nickel alloy parts, capable of cutting the most intricate designs even in the hardest known materials is demonstrated. In operation, the tool utilizes the magnetostrictive qualities of wrought nickel.

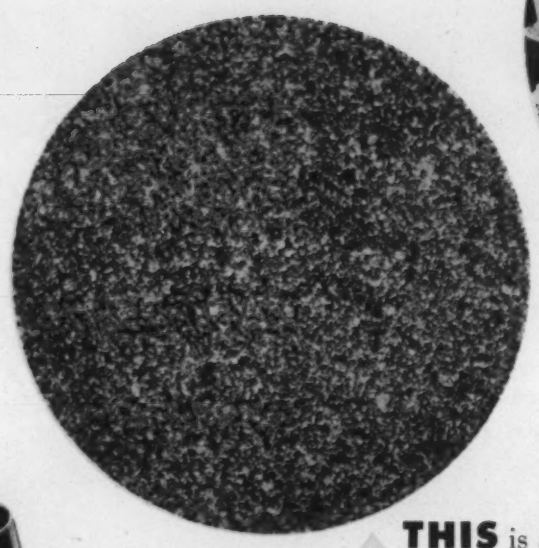
On the background panels are shown various uses of Inco Nickel Alloys, nickel-containing steels, stainless steels, nickel plating, cast products and special purpose alloys. Also six platinum metals are presented in various applications.

(Continued on page 168)

You don't need 3-D glasses

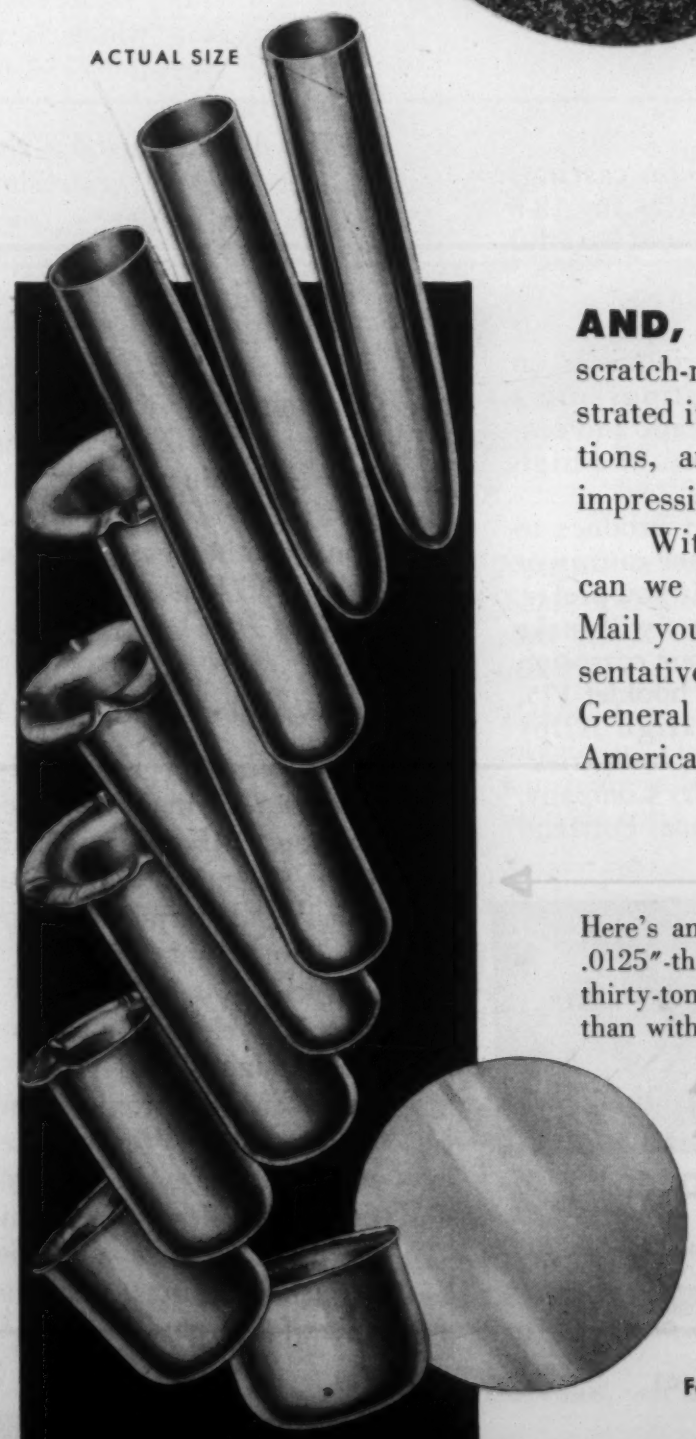
to see the difference

THIS is a 75X magnification of ordinary drawing brass—the kind that's been used for decades for stamped or drawn brass products.



THIS is a 75X magnification of super-fine-grain Formbrite.* Isn't it obvious that this new type of brass can be polished in half the time? Frequently, a simple color buff will bring up the desired finish for lacquering or plating.

ACTUAL SIZE



AND, Formbrite is harder, stronger, springier and more scratch-resistant than ordinary drawing brass, yet has demonstrated its remarkable ductility for forming and drawing operations, and ability to take sharp, clean-cut ornamental die impressions.

With all these advantages, Formbrite costs no more. What can we do to help you try this time and cost-saving metal? Mail you a booklet? Send you a sample? Ask our Sales Representative to call? Simply write to The American Brass Company, General Offices: Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario, Canada.

*Reg. U. S. Pat. Off. 5485

Here's an example of Formbrite at work. These pen caps are made of .0125″-thick Red Brass Formbrite strip at the rate of 2,000 an hour on a thirty-ton, 10-step multiple plunger press. Caps are buffed at a higher rate than with any other metal previously used.

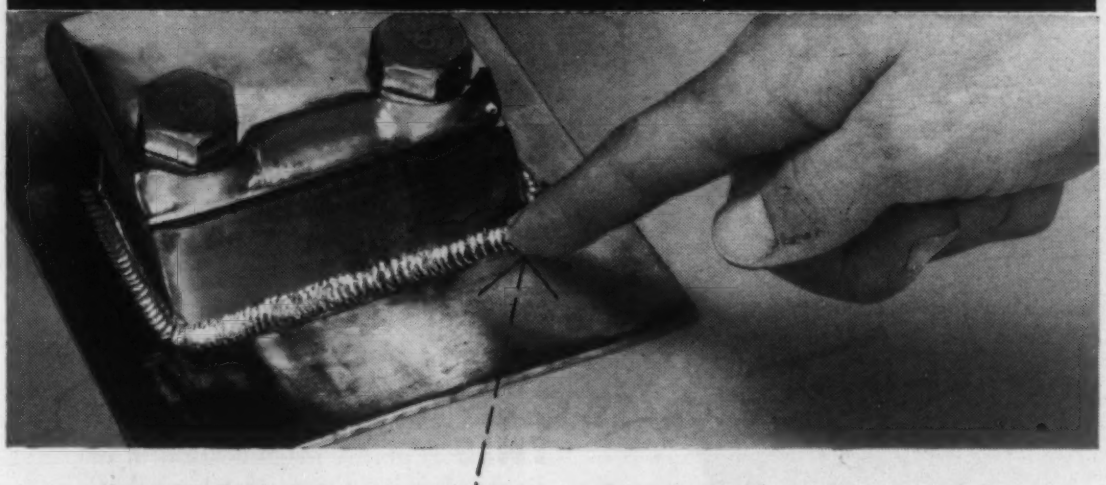
Formbrite DRAWING BRASS

an ANACONDA® Product

made by The American Brass Company

For more information, turn to Reader Service Card, Circle No. 389

Another ESCO first— 0.03 Max. Carbon Stainless Castings



...to stop CORROSION even at the weld

Now, for the first time you can specify 0.03 Max. Carbon stainless *castings,* in many forms, for greater corrosion resistance. *ESCO* offers static and centrifugal castings in all 18-8 and 18-8 MO analyses, which are *guaranteed to contain a maximum of only 0.03 per cent carbon.*

No Carbide-Dissolving Anneal Needed After Welding

Most castings must be welded to component parts during installation. The higher the carbon content of a casting the more "carbide precipitation" during welding. Carbide precipitation often means severe corrosion adjacent to welds—unless the casting is heat-treated after welding. Heat-treating after fabrication is an always difficult, sometimes impossible job.

ESCO 0.03 max. carbon castings can be welded into working position and be ready for action immediately —without loss of corrosion resistance. Result: Dependable, corrosion-resistant operation. A definite cut in operating costs.

Excellent Welding Characteristics

ESCO 0.03 max. carbon castings may be welded as easily as any 18-8 grade of stainless—without harmful *carbide precipitation.*

Available Now

ESCO welcomes your inquiries on 0.03 max. carbon castings and a wide variety of other static and centrifugally-cast stainless and high alloy products.

We are equipped to produce to your specifications on one casting or an entire installation. If you prefer, our high alloy engineers will make a complete study of your corrosion problems. Or write for booklet 175, "*Esco* Stainless and High Alloy Products for the Process Industries" to: Electric Steel Foundry Company, 2163 N. W. 25th Avenue, Portland 10, Oregon.

...the toughest corrosion problems wind up at...

ESCO

HIGH ALLOY DIVISION

ELECTRIC STEEL FOUNDRY CO.

Manufacturing Plants
2141 N. W. 25th Ave.
Portland 10, Oregon
712 Porter St.
Danville, Illinois

International Division and New York Office
420 Lexington Ave., New York City, N. Y.

Other Offices and Warehouses
Los Angeles, Centralia, Pa. Salt Lake City, Utah
San Francisco, Calif. Houston, Texas Honolulu, Hawaii
Seattle, Spokane, Wash. Medford, Eugene, Ore. In Canada, Vancouver, British Columbia and Toronto, Ontario

For more information, turn to Reader Service Card, Circle No. 461

Exhibits . . .

(continued from page 166)

Physical specimens on view include Alnico magnets, nickel-cadmium batteries, nickel steel aircraft parts, a color TV tube filter of cupro-nickel alloys and various other industrial equipment.

Janney Cylinder Co.
Booth No. 125

The exhibit consists of finished machined products made exclusively by centrifugally casting such metals as brass, bronze, aluminum bronzes, stainless steels, alloy irons, monel metals, and Ni-Resist irons. The special feature of the exhibit includes centrifugally cast finished machined parts of beryllium coppers and V2B (a hardenable 18:8 stainless alloy which is abrasion resistant, corrosion resistant and non-galling).

The display includes rings used in jet engines, extrusion press liners, shafts sleeves, pump and compressor liners, valve seat rings, diesel cylinder liners, cage blanks for ball and roller bearings, gear blanks, bushings, bearings casing and impeller rings and other miscellaneous cylindrical shapes that can be produced from centrifugal castings. Also included are Asarcon, continuous cast nonferrous tubes and bars.

M. W. Kellogg Co. Booth No. 320

Basic forms of Kel-F polymers—fluorocarbon molding powders, dispersions, oils, greases and waxes with exceptional chemical, electrical and physical properties—are being displayed.

Over 1000 examples of critical chemical, electronic and mechanical products are shown. Among these are electronic components and insulators for service under severe shock and electrical conditions; chemical hose, tubing and filters as well as containers and precision fittings; polymer film liners for drums, pipes and equip-

let us take a closer look at your

"difficult to solve" Problems Involving Tubing and Solids of Special Alloys and Cross Sections

Two years of experimental production and several thousand tons of finished extruded products have given B&W a background that can be put to work for you in solving problems involving tubing and solids of special alloys and cross-sections. Through extrusion at B&W:

1. *New alloys have become commercially available as seamless tubing.* These include certain proprietary alloys and various types of ferrous alloys which have been known previously as non-pierceable materials.
2. *Tubing having certain special cross-sections has been produced commercially.* This includes tubing having inside and outside shapes which are independent of each other, such as circular OD-finned ID, used to solve special heat transfer problems.
3. *Solids having special cross-sections have been produced.* These include shapes difficult or impossible to produce as rolled sections.

Through extrusion, Mr. Tubes, your local B&W Tubing Representative, has helped others to solve problems involving tubing and solids of special materials and cross-sections. Call on him if you have such problems; chances are he will be able to help you.

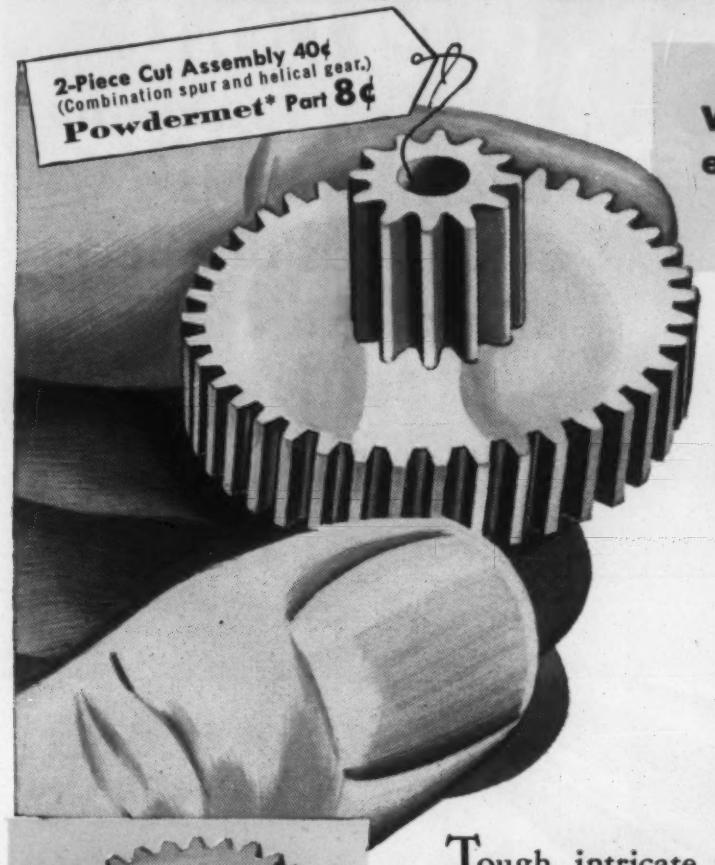
THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-4019(X)

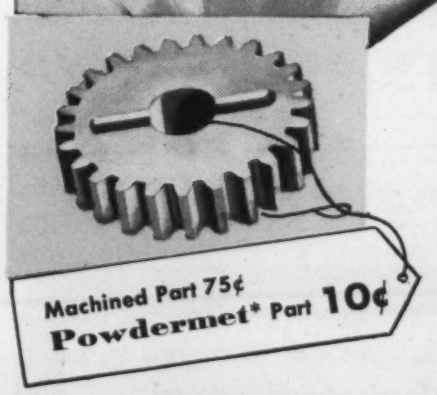
* For more information, turn to Reader Service Card, Circle No. 317

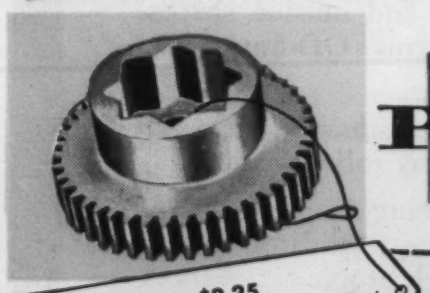
DON'T CUT PARTS ...Cut Costs!



Why pour money into expensive machining operations?

POWDERED METAL PARTS can do the job for *much less!*





Tough, intricate parts ready for assembly without further processing—at *savings of up to 600% over identical machined parts!* No wonder industry chooses Powdermet.*

Low-cost PM parts are die-pressed to close tolerances, have excellent wearability, and a wide range of alloys are available—many exceeding the tensile strengths of mild steel. Through controlled porosity and electrical permeability, many special properties are achieved . . . such as oil-impregnation for life-time self-lubrication. That's why Powdermet* parts are often the *best parts possible* for gears, bearings, filters, etc.

At Yale & Towne, years of experience and technological know-how in powder metallurgy back up every recommendation on PM parts for *your* particular application.

The world's most famous key
. . . symbol of industrial leadership!

YALE & TOWNE
MANUFACTURING COMPANY
PMP *Powdered Metal Products Division*
9335 Belmont Avenue • Franklin Park, Illinois

Visit us at the Basic Materials Show, Chicago, May 17-20. Booth 133.

*TRADE-MARK

—Send Today For Free Booklet—

The Yale & Towne Manufacturing Company
Powdered Metal Products Division
9335 West Belmont Avenue
Franklin Park, Illinois

☐ Send Booklet ☐ Send information on PM parts for attached specifications or drawings.
☐ Have a Yale & Towne Powdered Metal engineer call on me.

Name.....Title.....
Company.....
Address.....
City.....Zone.....State.....

Exhibits . . .

(continued from page 168)

ment for highly corrosive service; and examples of baked-on coatings for corrosive, "abhesive" and electrical applications.

Also featured are examples of the new "hot runner die" molding method for Kel-F and the new Kellogg Z.S.T. equipment and method for quality control of polymer part production.

La Salle Steel Co. Booth No. 240

The main feature of the exhibit is Stressproof, a specialty cold finished steel bar. Case studies and parts made from the material are on display. It is used in parts which require strength, wear and freedom from warpage.

Lignum-Vitae Products Corp. Booth No. 407

On display in the booth are Lignum-Vitae logs just as they are imported from the tropics, as well as dimension stock, rods, squares, etc. There are also blown-up photographs depicting all the stages of cutting, transportation and loading of the wood.

Hundreds of parts made of Lignum-Vitae are displayed, ranging from tiny pulleys ⅛ in. in dia by ½ in. long, to Step Bearings 12 in. in dia which are used in large electric turbines, as well as eight pieces measuring 48 in. in dia used in sewage equipment. There are also elevator guides, conveyor rollers, wire guides, door slides, sliding door parts, and many others.

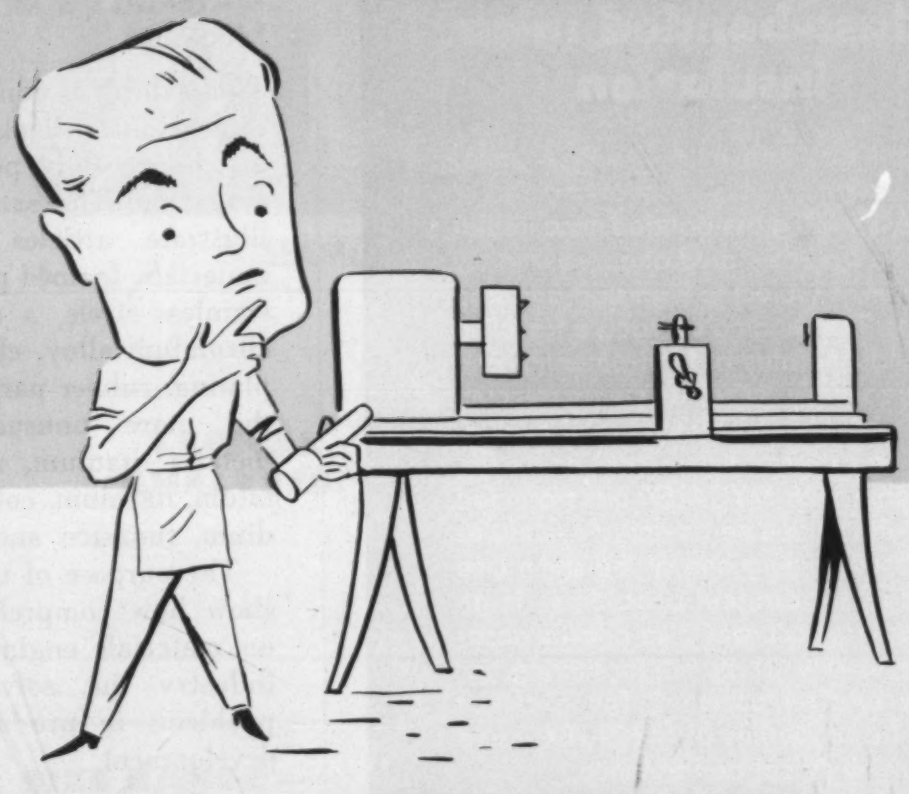
Malayan Tin Bureau Booth No. 131

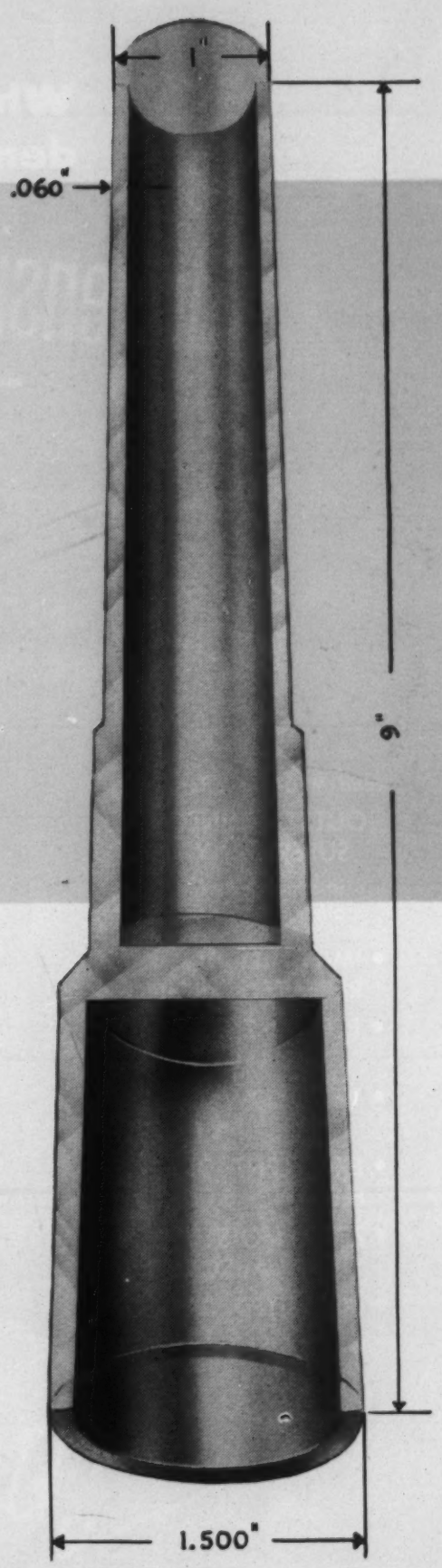
The exhibit demonstrates the properties of Straits tin from Malaya for metallurgical and chemical uses. Technical information is provided by experts from the Tin Research Institute, who will explain the latest developments in the use of the metal, such as tin-chemical treatment of jute fabrics for rot prevention. Also available

(Continued on page 174)

mr. design engineer...

could you machine this part in one piece?





No need to try when you specify...

HUNTER DOUGLAS IMPACT FORGING FROM HIGH STRENGTH ALUMINUM ALLOYS

Possibly this double diameter tube could be machined, but it is being made faster, stronger, and at less cost by the Hunter Douglas cold Impact Forging process. Formerly this tube was fabricated from three parts involving six operations with the resultant problem of leakage when subjected to high pressure. Impact Forging requires a single operation to produce this same tube that withstands a bursting pressure of *5500 p.s.i.* without distortion! The economies in production time are obvious. When you are designing a part with the following characteristics:

Walls of zero draft • *High physical properties* • *Tubular shapes with or without a closed end*
Close dimensional tolerances • *Mass production requirements up to a million or more a month*

REMEMBER THE NAME HUNTER DOUGLAS

We invite you to submit blue prints or sample parts for our engineering department's prompt analysis.

write for free brochure on your company letterhead

HUNTER DOUGLAS *CORPORATION*

DEPT. MM5• RIVERSIDE, CALIFORNIA • TELEPHONE RIVERSIDE 7091

For more information, turn to Reader Service Card, Circle No. 533

When the job demands precision

dimensional accuracy

– there's no substitute for MYCALEX® glass-bonded mica insulation

The coil form shown in this RCA-Victor precision tank coil is injection-molded of MYCALEX 410 glass-bonded mica insulation. The coil, operated at approximately 1000 rpm, is subject to high start and stop stresses. The winding contacts a traveling disc and operates at high potential and high frequency. MYCALEX was selected for this application after careful evaluation. The extreme dimensional accuracy, attainable with MYCALEX glass-bonded mica—the unique ceramoplastic—insures perfect contacting and at the same time eliminates balance problems. High dimensional accuracy also affords absolute uniformity of parts, facilitating assembly and replacement. The excellent dielectric properties of MYCALEX insure efficient electrical performance.

—and MYCALEX offers

OUTSTANDING SUPERIORITY

in almost every other category!

- IMMUNITY TO REPEATED ARCING
- PERMANENT DIMENSIONAL STABILITY
- VERY LOW LOSS FACTOR
- EXCELLENT DIELECTRIC STRENGTH
- ZERO MOISTURE ABSORPTION
- UNLIMITED DESIGN FLEXIBILITY

Note: MYCALEX 410 glass-bonded mica, described above, is an exclusive formulation of, and manufactured only by, the Mycalex Corporation of America. It meets all the requirements for Grade L-4B under Joint Army-Navy Specifications JAN-1-10.

For similar economical solutions to your problems, phone or write J. H. DuBois, Vice President-Engineering at the Clifton, N. J. address below.

SINCE 1919 MYCALEX® THE INSULATOR

MYCALEX CORPORATION OF AMERICA

World's largest manufacturer of glass-bonded mica products

Executive Offices: 30 Rockefeller Plaza, New York 20, N. Y.

ADDRESS INQUIRIES TO—

General Offices and Plant: 124 Clifton Blvd., Clifton, N. J.

For more information, turn to Reader Service Card, Circle No. 341

Exhibits . . .

(continued from page 170)

is information about tin production and marketing.

Samples of tin metal, alloys, chemicals, coatings, platings and solders are shown.

MATERIALS & METHODS
Magazine **Booth No. 311**

This exhibit is composed of three-dimensional displays of several articles recently published in the magazine. The samples displayed illustrate articles on sandwich materials, foamed plastics, welding stainless steels, a new aluminum-chromium alloy, electroless nickel plating, rubber parts, and eight of the more unusual engineering metals: titanium, zirconium, tantalum, hafnium, columbium, vanadium, tungsten and molybdenum.

The purpose of the exhibit is to show how comprehensive articles on materials engineering can aid industry in solving materials problems in product design and development.

Mica Insulator Co. Booth No. 123

The display features Isomica, the new micaceous insulation made from continuous mica sheet and available in hard or flexible plates, composite insulations, tapes and tubes. Class H insulation is also being shown made with silicone binders, suitable for applications where high heat and moisture resistance is necessary.

The booth also includes displays of Micanite, built-up mica splittings; Lamicoid, thermoset laminates, sheets, rods, tubes and fabricated parts; Empire, coated fabrics; and Fabricated Mica.

Mycalex Corp. of America Booth No. 117

This company is demonstrating Mycalex glass-bonded mica ceramoplastic, and insulation that withstands 2000 F for short periods. The products shown include the largest glass-bonded mica piece

GLOBE

specialization gives you
"Tops in Quality"

ALLOY STEEL TUBES

SEAMLESS — MECHANICAL — PRESSURE — CORROSION RESISTANT

TYPICAL ANALYSES:

Carbon	5 Chrome ½ Moly
Carbon ½ Moly	7 Chrome ½ Moly
½ Chrome ½ Moly	8 Chrome ½ Moly
1 Chrome ½ Moly	8 Chrome 1 Moly
1¼ Chrome ½ Moly	9 Chrome 1 Moly
2 Chrome ½ Moly	3% Nickel 7% Nickel
2¼ Chrome 1 Moly	5% Nickel 9% Nickel

AISI Types: 304-321-347-316-309-310-405-410-430-443-446

Analyses to meet conditions where heat, corrosion, pressure and structural strength are involved.

SIZE RANGE — WALL THICKNESS:

½ to 6 inches O.D. — wall thickness .035 to 1.000 inch.

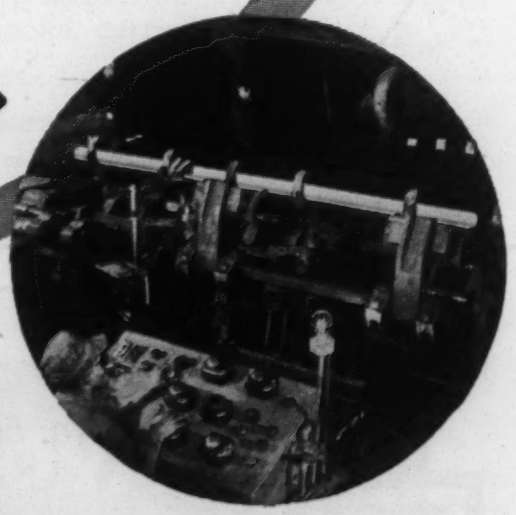
TYPICAL APPLICATIONS:

Pressure tubes — Superheater tubes — Condenser tubes — Still tubes — Evaporator tubes — Barrel tubes — Oil-well Pump Barrels — Mechanical tubes — Aircraft tubes — Propeller tubes — Rollers for Transmission Chains.

Globe engineers gladly give you the benefit of specialized knowledge of stainless steel tubing in a wide range of services and applications — to improve your product — to cut costs.

TO BE SURE . . . SPECIFY GLOBE

The heating, piercing, rolling of seamless tubes is controlled at every step for uniformity, close tolerance.



WHEN you specify Globe, you get uniform high quality alloy steel tubes, the product of highly developed production facilities and specialized quality controls and methods. All Globe tubes are thoroughly inspected and closely held within tolerance specifications. Write for the Globe general catalog.

GLOBE STEEL TUBES CO.

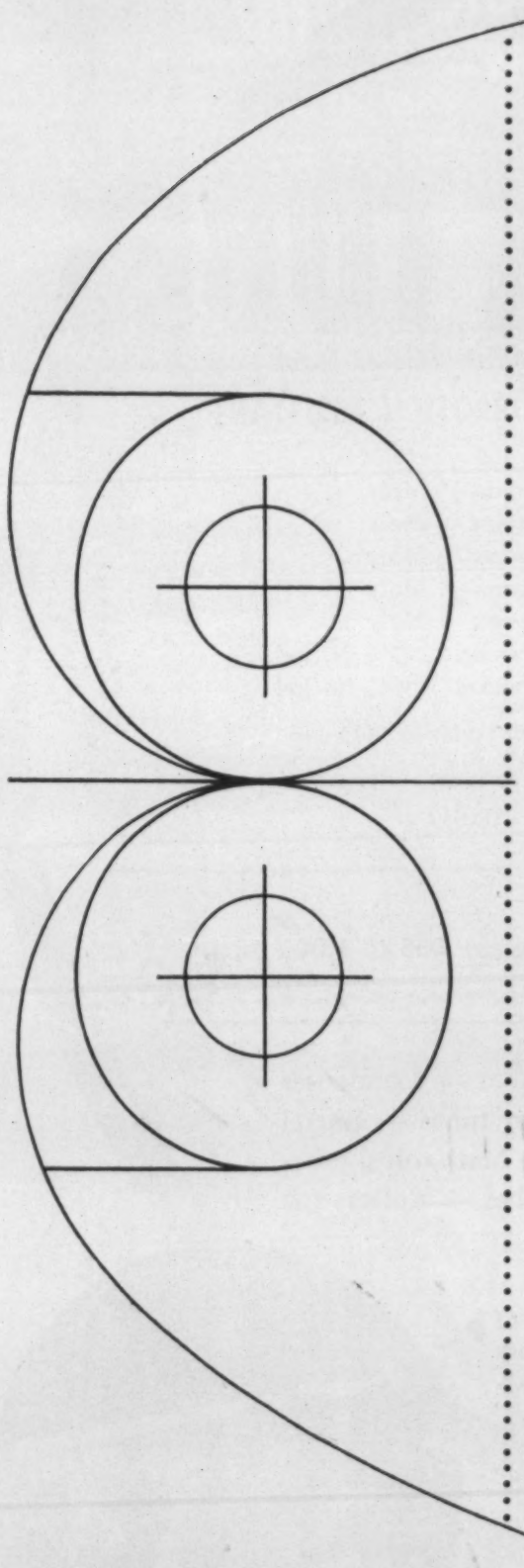
Milwaukee 46, Wisconsin Chicago • Cleveland • Philadelphia • St. Louis • New York Detroit • Denver • Houston • San Francisco • Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld stainless steel tubes — alloy — carbon — seamless steel tubes — Globeiron (high purity ingot iron) seamless tubes — Globe Welding Fittings.

For more information, turn to Reader Service Card, Circle No. 402

Dobeckmun creates...

new flexible materials for industry



Laminations

Colorfilm® • Plasticolor®
Doplex Brilliant® • Dobar®

From colorful graphic arts papers to space-saving electrical insulating materials, Dobeckmun's laminating facilities create unique products by the skillful bonding together, with special adhesives, films, foils and papers.

Coatings and Extrusions

Custom Coatings

Polyethylene and vinyl applied to cloth or papers are creating greaseproof, heatsealing, functional use materials for an endless variety of industries.

Narrow Gauge Slitting

Lexel®

Skillfully controlled knives ground to a microscopic fineness enable Dobeckmun to slit the most delicate materials to widths as narrow as 1/100 of an inch.

Barrier Materials

Glass-Tak® • Excello-Seal®
Metalam® • Benbar®

Metalam, laminated combinations of aluminum foil and other materials; Benbar, greaseproof papers, are Dobeckmun's industrial packaging materials manufactured to rigid government specifications.

Lurex

Lurex® • Notarn®

The Metallic Yarns that never tarnish used in an effective marriage with other fibers, provide a lasting glitter for high fashion and home furnishing fabrics the world over.

Visit us at Booth No. 502

Dobeckmun Company, Cleveland 1, Ohio • Berkeley 2, Cal. • Bennington, Vt.
Subsidiary: The Floyd A. Holes Company • Bedford and Madison, Ohio

Exhibits . . .

(continued from page 174)

ever molded, a machinable grade of Mycalex ceramoplastic rated at 2300 F and several types of AN connectors injection-molded of the material.

Some of the end products made of the material are Mycalex 410 telemetering commutators and switches, coil forms for coded radio, air circuit breaker arc chute, molded-with-fragile-inserts switch for correcting gyro compensation, radio frequency switch, minimum differential expansion spur gear, functional parts with solderable molded-in inserts, and printed circuits.

National Lead Co.
Booth Nos. 132, 134, 140

For the first time in any trade show several members of the National Lead family are joined in one group.

The Doehler-Jarvis Div. demonstrates the space, weight and moneysaving possibilities of die-cast components of aluminum, magnesium and zinc.

The Titanium Alloy Div. shows how titanium and zirconium products are employed in several industries, including metal-working, chemical, ceramic and pharmaceutical.

The Lead Products Div. displays new methods of lead equipment construction that apply to chemical processing operations. The role played by lead in radiation shielding is also demonstrated.

National Vulcanized Fibre Co.
Booth No. 241

In this booth is displayed a new punching laminate featuring high dielectric strength, arc resistance and low water absorption. Also shown are various parts fabricated from vulcanized fiber and phenolic melamine and silicone laminates that enter into almost every field of industry.

(Continued on page 178)

For more information, turn to Reader Service Card, Circle No. 435

Portable Protection...

a Case for U. S. Royalite!

Cutlery, tote boxes, ampoules, ointment tubes, salesbooks . . . a completely unrelated group of items, *but* they all had to be packaged to go somewhere, usually in a hurry, and arrive in perfect condition. This was the problem confronting the Fabri-Kal Corporation of Kalamazoo! They needed a material to fit every case and insure full protection, yet be easy and economical to work with. Fabri-Kal was sure—here was a case for U. S. Royalite!

This tough thermoplastic proved itself more than equal to every need. For cutlery, a strong display package that would attract the eye at point-of-sale and be a serviceable case that would wear well and be a handsome addition to a home. Medical ampoules and tubes, so fragile to handle, were fitted securely in strong formed inserts of U. S. Royalite that held them firmly in a snap-grip fit. And salesbooks, carried from place to place, always in use, found U. S. Royalite's durability and appearance far superior to any other material. U.S. Royalite was the one answer Fabri-Kal found to its problems. Why not let it serve you, too? For complete information, write to the address below.

U.S. ROYALITE®
TOUGH PLASTIC PRODUCTS

US RUBBER

UNITED STATES RUBBER COMPANY
ROCKEFELLER CENTER · NEW YORK

For more information, turn to Reader Service Card, Circle No. 505

Permanite is a thermosetting furfuryl alcohol resin, which can be fabricated into many types of corrosive handling equipment. It can be supplied in almost any shape from valves to large towers. Permanite Equipment is corrosion-proof throughout its entire body. It will handle most acids including HF, HCl, as well as oils, alkalies and organic solvents at sustained temperatures in excess of 240°F. It is lightweight but very dense, strong, and shock resistant.

Permanite, reinforced with chemical fiberglass, is fabricated into complete functional units such as tanks, absorbers, towers and fume washers. It is also available in lightweight pipe and fume ducts. Permanite can be molded into a variety of finished units such as valve bodies, trays and bubble caps.

Permanite equipment requires little maintenance. Its light weight provides an added advantage — ease of handling and installing.

Knight engineers are glad to cooperate in designing Permanite equipment to specification. Send for illustrated Bulletin No. 6 — Permanite Equipment, Bulletin No. 1 — Permanite Pipe and Ductwork or Bulletin No. 15 — Permanite Diaphragm Valves and learn how Permanite can help solve your corrosion problems.

Maurice A. Knight 741 Kelly Ave., Akron 6, Ohio

Acid and Alkali-proof Chemical Equipment

For more information, turn to Reader Service Card, Circle No. 467

Exhibits . . .

(continued from page 176)

Penton Publishing Co.
Booth No. 220

The exhibit includes displays of *Machine Design*, *Steel*, *Foundry* and *New Equipment Digest*. Also included are technical books published by the company.

The Polymer Corp. Booth No. 408

The booth features four basic industrial materials: 1) nylon in stock shape for rapid fabrication on standard metalworking equipment; 2) Nylasint, a nylon powder for molding by powder metal techniques; 3) Teflon stock shapes for electrical and chemical uses; and 4) a high-temperature cross-linked styrene known as Q-200.5.

Reinhold Book Div. Booth No. 311

Reinhold Book Div. is exhibiting a selected group of technical books pertaining to the technology and uses of metals, nonmetals, metals processing, and chemicals. Orders for books may be placed at the booth. Catalogs and other literature describing all Reinhold books are available.

Reynolds Metals Co.
Booth No. 110

Latest design, application and fabrication information on aluminum, together with typical examples are being displayed in the Reynolds Booth.

Production samples of aluminum products that demonstrate latest design techniques are on display. Examples of decorative finishes using aluminum powders and pastes in paints and lacquers are shown in a wide range of colors and effects.

Rigidized Metals Corp.
Booth No. 135

Two new textured metal patterns are featured in addition to about 40 other standard patterns including custom designs for special

The Properties of Straits Tin

No other metal combines all the properties of Straits Tin. No other metal can do so many different kinds of jobs so economically and so well.

Because it is corrosion-resistant, nontoxic and tasteless, tin is a perfect metal for the packaging of food. Today more than 400 different food products come in tin cans. Currently, more than half of the tin for these cans is Straits Tin from Malaya.

Because it wets metals readily, flows easily, adheres firmly, and has a relatively low melting point (450°F.), tin is the key component of solder. And tin-rich solders are the best and most efficient means for making corrosion-resistant, impermeable, electrically conductive joints at low temperatures.

A unique combination of properties makes Straits Tin a particularly useful component of bronzes. Tin hardens and strengthens copper twice as effectively as zinc, and provides much better resistance to corrosion.

Because of its antifriction qualities, resistance to corrosion, conformability, and good embedding characteristics, tin is invaluable in bearing metals. Without tin-base or tin alloy bearings, the wheels of industry could not turn so smoothly and efficiently.

And Straits Tin is not only one of our most useful metals. It is now fast becoming one of our most valued chemicals. Tin in chemical compounds — stabilizers, opacifiers, antioxidants, preservatives — is contributing greatly in the competitive race for improvement in products from plastics and the new chlorinated rubber paints to ceramics, sensitized paper — now even jute bags.

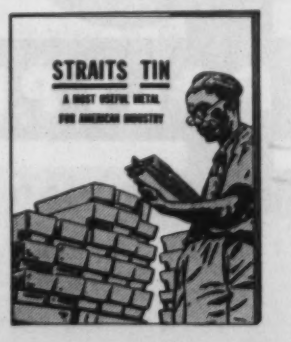
Take a New Look at Straits Tin

Over one-third of the world's tin is mined and smelted in Malaya. Known as Straits Tin, this metal is over 99.87% pure, and is world-famous for its absolute reliability of grade.

Today new uses for Straits Tin are making it more valuable than ever to American industry. And continuing research will, in the near future, find still more ways in which Straits Tin can serve you. Whether you're planning a new product, improving an old one, or seeking ways to avoid the squeeze between rising costs and resistance to higher product prices, a careful reappraisal of the properties of Straits Tin may uncover a profitable answer to your problem.

MALAYAN TIN BUREAU

A new booklet, "Straits Tin: A Most Useful Metal for American Industry," tells a factual and intriguing story of the many new ways tin can be used today. A copy is yours for the asking.



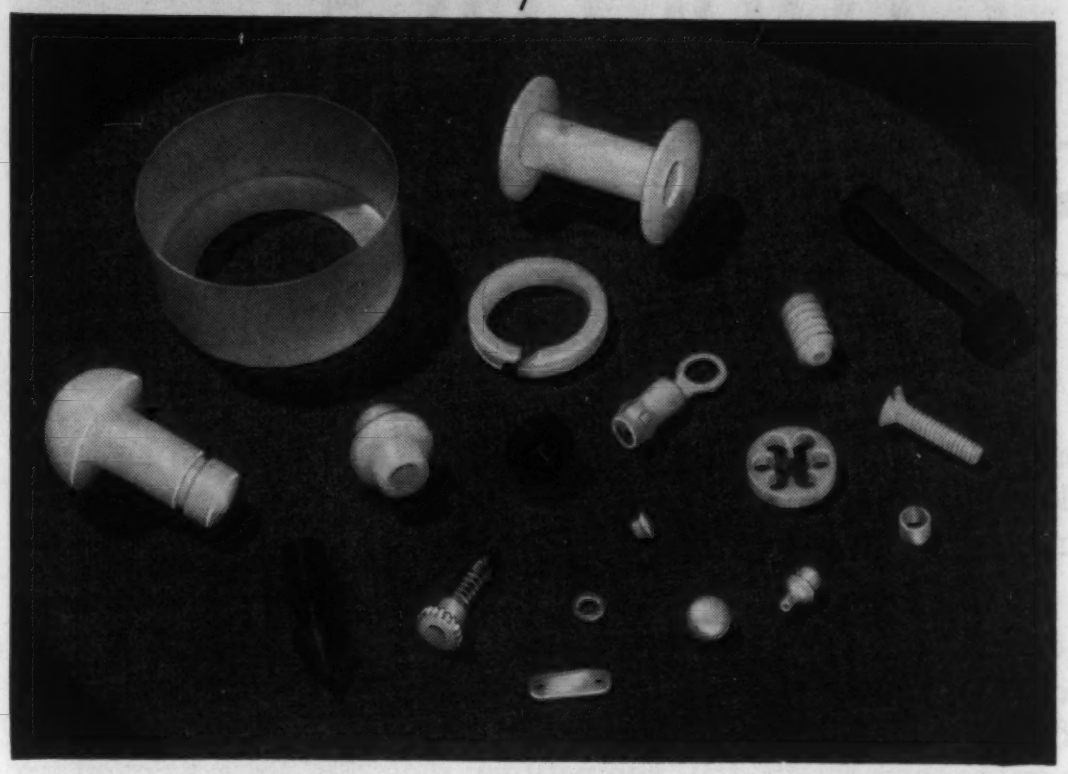
THE MALAYAN TIN BUREAU

Dept. 686, 1028 Connecticut Ave., Washington 6, D.C.

For a more complete picture of the new uses for Straits Tin today, visit Booth 131, Basic Materials Exposition, Chicago, May 17-20.

For more information, turn to Reader Service Card, Circle No. 523

WHEN YOU WANT NYLON PERFORMANCE
with low tooling cost... design with
POLYPENCO® ROD, STRIP, TUBING



APPLICATIONS
Bearings
Connectors screws—rivets
Coil forms
Gears
Rollers
Thrust washers
Valve seats
Wearing surfaces
Insulators

CHARACTERISTICS
Abrasion resistance
Electrical insulation
Light weight
Heat resistance
Quiet operation
Toughness
Resilience
Low coefficients of friction

You can fabricate parts readily (drill, tap, thread, turn, mill, blank) from standard shapes of POLYPENCO nylon on standard shop equipment. This keeps tooling cost low and makes nylon economical without costly tooling.

Call on us for engineering help. We will tell you if nylon is practical for the application, how to fabricate it—or we will fabricate it for you. Write for prices or technical data.

POLYPENCO NYLON
nylon and teflon*/stock shapes, finished parts
also available to your specifications

The POLYMER CORPORATION of Penna. • Reading, Penna.
In Canada: Polypenco, Inc., 2052 Saint Cathrine, West, Montreal, P.Q.
* registered trademark of the Du Pont Company

For more information, turn to Reader Service Card, Circle No. 489

Exhibits . . .

(continued from page 178)

uses by leading manufacturers.

The floor of the booth is covered with Rigid-Tex Metal and a display of case-history photographs illustrate the use of textured metals for everything from decorative plates on household appliances to structural building applications.

Visitors may pick up samples of Rigid-Tex Metals to test its strength and mar-resistance themselves.

Rohm & Haas Co. Booth No. 233

Plexiglas acrylic plastic molding powders and Paraplex polyester resins for molded, laminated and reinforced plastics are featured in the exhibit. The display also shows current uses of the materials in a variety of industries.

Included in the acrylic molding powder section of the exhibit are new control dials for air conditioning systems, medallions and nameplates for electric stoves and refrigerators; also a variety of decorative and functional new parts for automobiles.

Reinforced plastic luggage, lamp shades, modern chairs and fishing rods are among the end-products high-lighted in the polyester resin section, together with the latest translucent corrugated panels for architectural and industrial use.

South Florida Test Service Booth No. 722

A continuous showing of colored slides depicts the facilities and tests at four locations in southern Florida. These are: main inland proving grounds, laboratory and storage warehouse; salt atmospheric proving grounds 175 ft from the Atlantic Ocean; tidewater immersion test location in sea water; and total immersion test location in sea water.

Slides show tests on protective coatings, plastics, rubber, textiles, plating, metals and related materials and products.

(Continued on page 182)

Announcing the

1954 redesign contest for Gray Iron castings

1st prize $500.00
2nd prize $250.00
3rd prize $100.00

Here's your opportunity to cash in *twice* on the products or parts you have redesigned for production in Gray Iron.

First: because the unique characteristics and castability of Gray Iron helped you replace a competitive material . . . more economically and more efficiently.

Second: by entering your redesign project in the Fifth Annual Gray Iron Founders' Society's *Redesign Contest* and win one of the substantial cash awards.

Here's all you have to do . . .

1. Select the best example of products or parts that you have redesigned for production in Gray Iron.

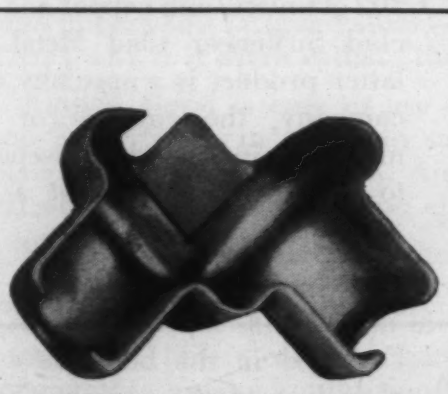
2. Give the facts for this switch to Gray Iron . . . how much you saved in labor and material costs . . . how much efficiency you gained and any other factors that led you to this decision.

3. Submit an 8″ x 10″ glossy photo of the Gray Iron casting with your entry. And, if possible, submit a similar photo of the original product or component.

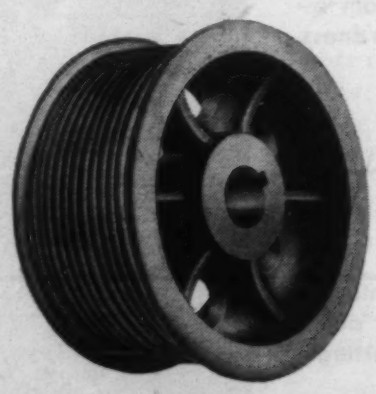
4. Get your entry in by JUNE 1, 1954 . . . closing date for contest. Address: *Redesign Contest*, Gray Iron Founders' Society, Inc., National City E. 6th Bldg., Cleveland 14, Ohio.

5. Contest is open to all persons engaged in the metalworking trades . . . entries may be entered jointly by two or more individuals.

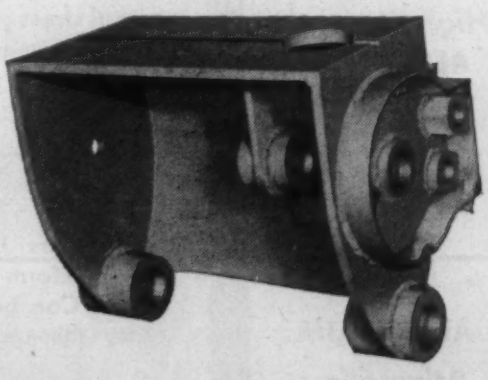
Examples of previous award winners . . . featured in the Society's recent National Trade Advertising



Production costs were cut 90% by redesigning this gear cover in Gray Iron to replace the original fabricated cover.



This cable drum was redesigned for production in Gray Iron with a cost saving of 41% per unit.



By redesigning this gearbox in Gray Iron, 45% was saved on original cost of fabricated gearbox . . . 41% on machine and labor costs.

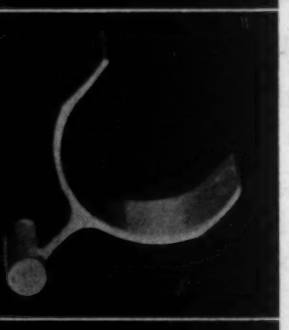
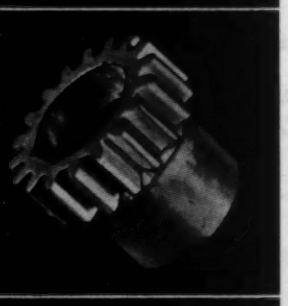
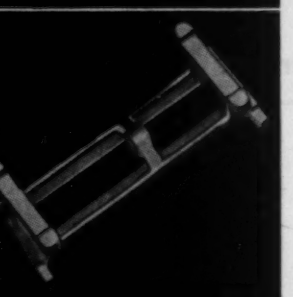
GRAY IRON FOUNDERS' SOCIETY, INC.
NATIONAL CITY-E. 6th BLDG., CLEVELAND 14, OHIO

• For more information, turn to Reader Service Card, Circle No. 403

ATLANTALLOY

PLASTER MOLD CASTINGS CAN SOLVE YOUR DESIGN PROBLEMS

Atlantalloy plaster mold precision castings provide non-ferrous castings *cast to ordinary machining tolerances*, effecting definite savings in machining and other costly operations. Atlantalloys are characterized by high strength, durability, and many other advantages.

NO. 10 YELLOW BRASS *Atlantalloy*	An all-purpose alloy for brush boxes, gears, levers, etc. Fine grain, clean, smooth surfaces assure tightness. Easily machined. Free from porosity. Fatigue resistant.	
NO. 20 ALUMINUM BRONZE *Atlantalloy*	Excellent for gears and bearings. Strong, light, zinc-free. Highly resistant to corrosion. Machines well.	
NO. 31 *High Tensile* MANGANESE BRONZE *Atlantalloy*	High strength engineering material for gears, valve bodies, electrical mechanisms, etc. Extremely durable. No heat treatment needed. Can be cast in thin sections.	
NO. 40 *High Strength* ALUMINUM *"Tenzalloy"*	Attains high strength through natural aging. Free from internal stress and skin hardness. Ideal for machining.	
NO. 60 ALUMINUM *Atlantalloy*	Perfect as instrument alloy. Fully uniform with no internal strain. Can be used for accurate, thin-sectioned castings.	
WRITE . .	for free copy of "Quality Precision Castings for Industry." Get full data on our plaster mold process and alloys.	

ATLANTIC CASTING and ENGINEERING CORP.

Established 1937

810 Bloomfield Avenue • Clifton, N. J. • PRescott 9-2450

For more information, turn to Reader Service Card, Circle No. 357

Exhibits . . .

(continued from page 180)

Sperry Products, Inc. Booth No. 412

The company is showing two of their latest model ultrasonic reflectoscopes. The instruments are operated in actual demonstrations of inspection of raw materials and finished parts.

The exhibit also contains explanations of the various methods of testing with these instruments to meet requirements of different industries and applications.

A large blackboard is used to discuss visitors' testing problems.

Star Porcelain Co. Booth No. 235

Exhibited are hundreds of different shapes and sizes of parts manufactured by Star Porcelain Co., together with complete data on the many formulas produced. Also shown are several applications of their ceramic material on completed assemblies.

Superior Steel Corp. Booth No. 330

Included in the display are stainless and clad strip steels manufactured by the company and a large number of products fabricated from these metals.

Featured are Superior's Type 302 stainless, and copper and brass clad SuVeneer Clad Metal. This latter product is a specialty of the company, the copper (or other metal) being bonded inseparably to one or both sides of a plain steel core.

Superior Tube Co. Booth No. 425

Featured in the booth is a complete line of the company's small diameter tubing, samples being taken from the 55 analyses in standard production.

Removable round and shaped sample tubes, 8 in. long, are shown which cover 8 major product groupings: stainless steel, carbon steel, alloy steel, nickel and nickel alloys, glass sealing alloy, titanium, beryllium copper and a special grouping of miscellaneous analyses.

(Continued on page 186)

Sand-cast water wheel — 12,000 lbs.

Extruded solids, hollow rounds, and shapes.

Kaukauna Machine Corporation fights wear and high bearing pressures with

AMPCO* METAL

THE ability to stand up year after year in tough machine-tool service proves that Ampco Metal can really take it.

And Ampco Metal — a series of special alloys — adds longer life to both your product and production equipment, gives you lower costs, less grief. Here's why:

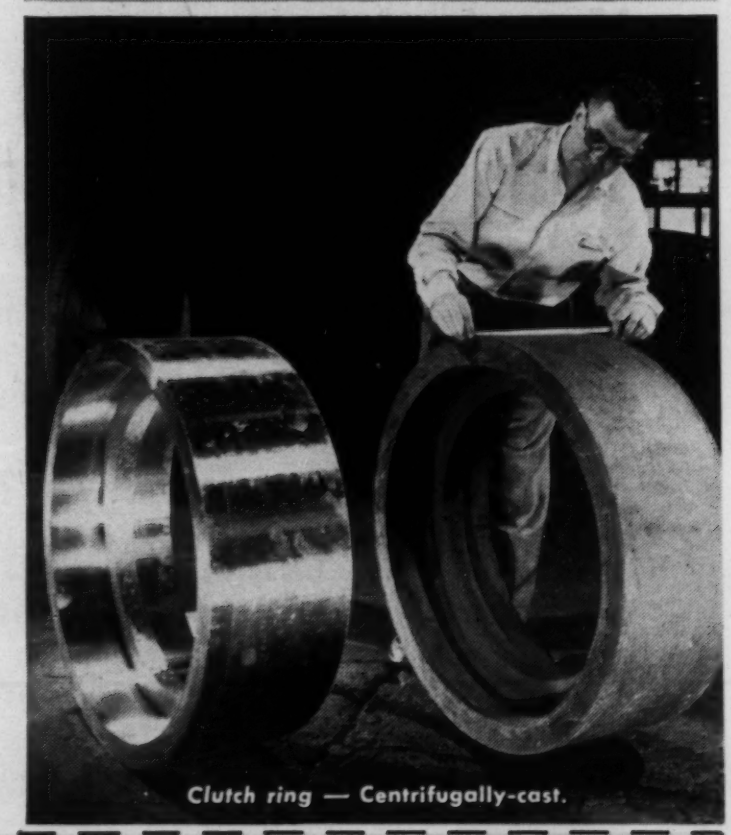
Ampco Metal has high compressive strength — won't squash out. It has remarkable resistance to wear in all its forms — abrasion, corrosion, erosion, cavitation-pitting, etc. Ampco Metal gives you high impact and fatigue values — makes a superior bearing material. That's why it is often called "the Metal without an Equal."

Ampco Metal is easy to use — available in practically any form you need. You can get it in sand and centrifugal castings, sheet, plate, fittings, and fasteners. Also available as forgings, tubes, bars, extruded shapes, and welding electrodes and wire.

Perhaps Ampco Metal is the answer to wear, shock, load, and many other troublesome problems you face. Let it help you to build greater customer satisfaction into your product, or to obtain higher production, lower costs, longer runs in your plant. Get complete information on any application from your nearby Ampco field engineer or write us.

*Reg. U. S. Pat. Off.

In Milwaukee stock — Grade 24 solid rounds, rectangles, centrifugally-cast die blanks.



Clutch ring — Centrifugally-cast.

Tear out this coupon and mail today!

Ampco Metal, Inc.

MILWAUKEE 46, WISCONSIN

WEST COAST PLANT, BURBANK, CALIFORNIA

AMPCO®

mettle

LET AMPCO PROVE ITS ~~METAL~~

AMPCO METAL, INC., Dept. MD-0, Milwaukee 46, Wisconsin

I'd like to know more about Ampco Metal. Kindly send me your descriptive literature without obligation.

Name..... Title.....

Company.....

Company Address.....

City.....(.....) State.....

D-24

Here's what micarta® LAMINATED PLASTICS is doing for automobile engines!

A leading automobile manufacturer wanted a timing gear that was slow-wearing, silent in operation, low in cost. Now, more than six million MICARTA timing gears are performing efficiently in engines.

What can Micarta do for you?

Your problem may be as simple as noise control, or electrical insulation. Perhaps you need a material that is both light and strong, that resists corrosion, withstands vibration, heat, cold or compression. Whatever your problem, your industry, or your application, investigate the qualities of versatile MICARTA.

For prompt and complete information, fill out the coupon below.

YOU CAN BE SURE...IF IT'S Westinghouse

micarta is basic!

Westinghouse Electric Corporation
MICARTA Division, Trafford, Pa.
Attention: L. A. Pedley
Sir: (Please check one)
☐ Please have your representative call
☐ Please send me the complete facts on MICARTA

Name_____ Company_____
Address_____
City_____ Zone___ State_____
J-06511

Exhibits . . .

(continued from page 182)

These tubing samples illustrate such products as super pressure, mechanical, hypodermic needle, Bourdon, capillary and hydraulic tubing a well as an unusual collection of fabricated television and radio receiving tube parts.

Sylvania Electric Products, Inc. Booth No. 120

The main feature of the booth is color television. The exhibit shows a color TV set from its very beginnings in basic materials—such as phosphors and glass—to the cutaway picture tube, to the finished set. When possible, a color program is being shown.

Also included in the booth are products from the Radio Tube Div., Television Picture Tube Div., Parts Div., Electronics Div., Lighting Div., Radio and Television Div., and Tungsten and Chemical Div. These Divisional displays include such products as a germanium ingot, fine-drawn wire, phosphors, tungsten rod, fluorescent powders, and plastics, all made by the company.

Synthane Corp. Booth No. 501

On display are the company's thermosetting laminated plastic materials and fabricated products. Among the complex parts being shown are a number of molded-macerated and molded-laminated parts.

Specialty products being displayed are metal-clad laminates used for printed circuits, the G-8 glass mat laminate combining high fire and arc resistance with good chemical resistance, a flame retardant laminate which will not support combustion and reduces afterglow effects, and a silicone-glass laminate (continuous filament) which incorporates high heat resistance, low dielectric loss and retains its properties under either humid or dry conditions.

Taylor Fibre Co. Booth No. 141

Shown in the booth is a complete

For more information, Circle No. 405

Designed for Lasting Beauty with REVERE ALUMINUM

More and more manufacturers of commercial products have turned to Revere Aluminum because of its high strength, workability and lasting beauty. And with Revere Aluminum they are assured of a fine, uniform quality.

Revere meets your requirements with a wide range of aluminum alloys in extruded shapes, coiled sheet, drawn tube, electrical bar and forgings. And for assistance with a specific problem, the Revere Technical Advisory Staff is ready to serve you. For the best in aluminum or technical assistance . . . call Revere.

REVERE ALUMINUM

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N.Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

For more information, turn to Reader Service Card, Circle No. 434

DURASPUN

Centrifugally Cast Pipe

is Better Pipe

Centrifugal castings are superior castings. The metal is sounder, finer-grained, more uniform. It is free of gas pockets, blow holes and other defects often difficult to keep out of static castings. Tensile strength is close to that of rolled or hot-forged alloy steel. Dimensions are accurate, usually requiring less machining and finishing and thus speeding production.

If you require *extra* qualities in your high alloy pipe, investigate DURASPUN Centrifugally Cast Pipe. We can produce it in OD ranging from 2½" to 24" and in lengths up to 15' according to diameter. Our experience in the field of centrifugal high alloy castings dates back to 1931. Our experience in the field of static high alloy casting goes back to 1922. We can give you good service.

THE DURALOY COMPANY

Office and Plant: Scottdale, Pa. · Eastern Office: 12 East 41st Street, New York 17, N.Y.

Detroit Office: 23906 Woodward Avenue · Pleasant Ridge, Mich

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METAL GOODS CORP. Dallas · Denver · Houston · Kansas City · New Orleans · St. Louis · Tulsa

For more information, turn to Reader Service Card, Circle No. 320

Exhibits . . .

(continued from page 186)

line of laminated plastics with paper, canvas, linen, glass, asbestos and nylon bases in various combinations with phenol, melamine, silicone, and epoxy resins.

Special emphasis is being placed on the new 300 series of hot punch, paper base, phenol laminates having very high electrical and mechanical properties for laminates of this class. Another feature is Taylor's newest development, glass reinforced polyester rod in a complete range of primary and secondary colors.

A line of vulcanized fiber is being shown along with sample pieces made of both laminated plastics and vulcanized fiber to emphasize the completeness of the company's fabricating facilities.

Time Magazine Booth No. 302

"Time Opens the Doors to Industry" is an audience participation booth. Doors open, cartoon figures move, lights blink, and the visitors are told in this graphic fashion of *Time's* penetration of the industrial market.

The purpose of the exhibit is to show how and why industrial advertisements in *Time* reach the nation's biggest and best market for basic materials for industry.

United States Testing Co., Inc. Booth No. 334

The exhibit demonstrates how the company obtains and evaluates data concerning basic materials. From the raw materials to the end use of the finished products, technical data are basic requirements.

U. S. Testing shows how through research, testing and product evaluation, the proper basic material can be selected. Testing instruments are on display.

Western Felt Works Booth No. 215

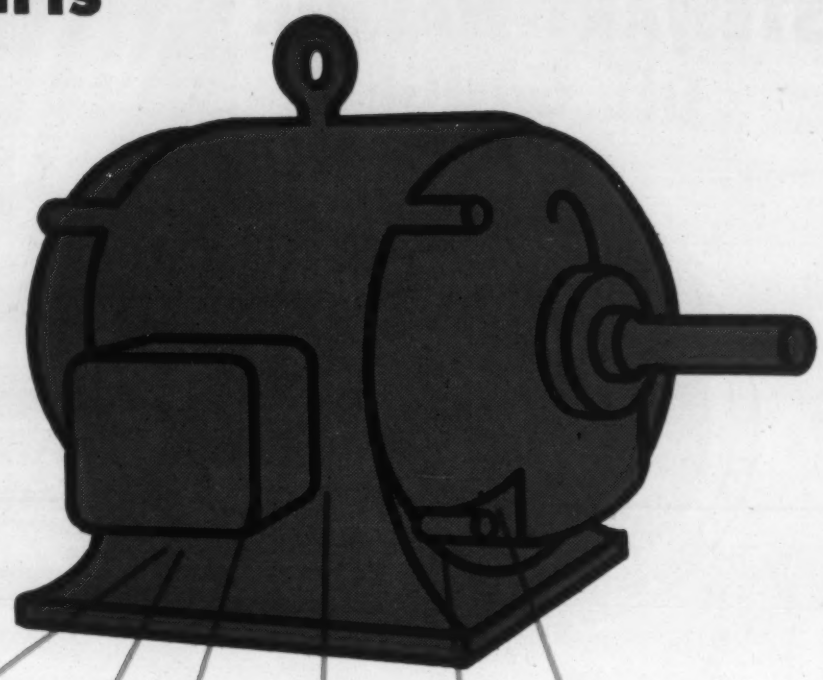
The purpose of the exhibit is to show the increasingly important roles felt and synthetic rubber play in meeting modern industry's most exacting requirements. New

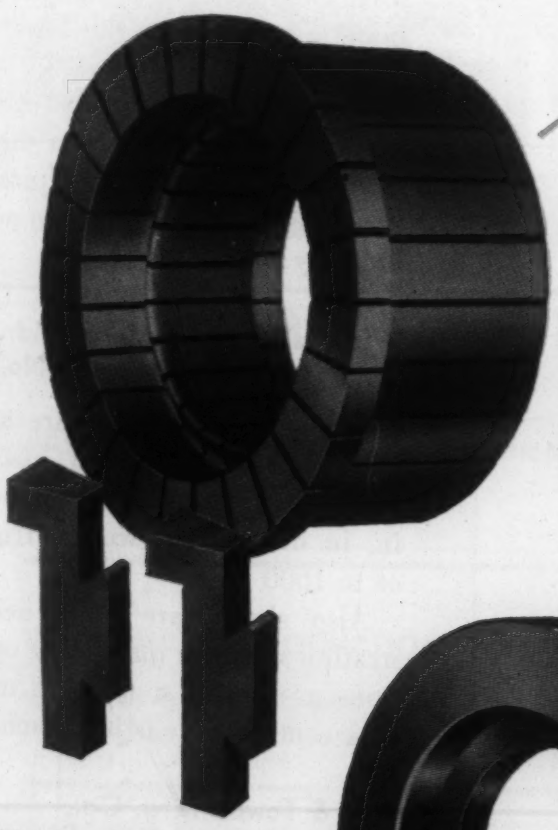
(Continued on page 192)

For more information, Circle No. 552

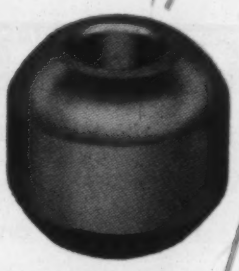
dependable electric motors use GRAMIX® parts

In many and varied motor applications, GRAMIX sintered metal parts are proving their strength and durability in rugged daily service because they are designed and made by men who really know motors ... men who have years of experience in the field. This is a plus factor for you because in addition, GRAMIX parts cost less than those made by conventional methods, cut manufacturing time, eliminate machining, and can be delivered faster! Why not write today for our big new GRAMIX catalog or the specific engineering information you need to put GRAMIX parts to the best use in your equipment?

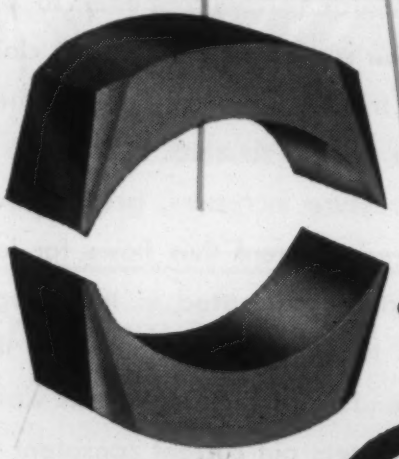




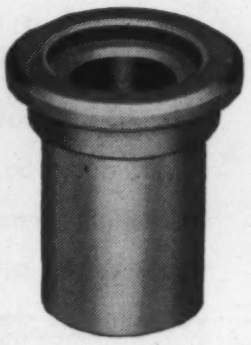
GRAMIX commutator segments



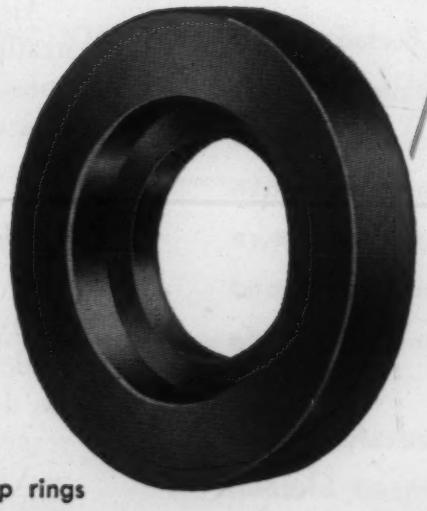
GRAMIX bearings



GRAMIX pole shoes



GRAMIX bearing inserts



GRAMIX slip rings

USG carbon graphite brushes and contacts give efficient and dependable service on all types of rotating electrical equipment. Field tests show that they can do a better job for you. Write today for catalog.

OUR 100th YEAR

102

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

• For more information, turn to Reader Service Card, Circle No. 512

how CHACE THERMOSTATIC BIMETAL INDICATES IN THE STEWART-WARNER OIL GAUGE

A Product of Stewart-Warner Corp. • Chicago 14, Illinois

Stewart-Warner's Thermo Electric Oil Pressure Gauge uses two Chace Thermostatic Bimetal elements of hairpin form to give the ultimate in accuracy for engine oil pressure indication. Using a "Double Bimetal Circuit," the oil pressure is transformed into interrupted electric currents at the S-W "sending" unit, (see drawing). When line (1) is energized and there is no oil pressure, contacts (2) are closed lightly. Resistor coil (3) heats bimetal (4) which bends to open contacts and break circuit. Bimetal then cools and the contacts close, completing a cycle of short duration. A trickle of current flows to the gauge, heating bimetal elements to move pointer to zero.

When oil pressure increases, pressure on contacts increases and opening is delayed. Current thus flows for longer periods during the cycling, more heat is generated in the gauge bimetal elements and pointer is forced to higher reading. While the current fluctuates, lag in heating and bending of bimetal arrests vibration of pointer. Actually the sending unit meters out current consistent with oil pressure and the gauge records it. Many manufacturers throughout the world who make products which are actuated by bimetal response to temperature changes, specify Chace Thermostatic Bimetal. Chace assures large and small users of a reliable source of supply of bimetal to meet a wide variety of specifications.

Write today for our new 36-page booklet, "Successful Applications of Thermostatic Bimetal," containing condensed bimetal engineering data.

W. M. CHACE CO.
Thermostatic Bimetal
1615 BEARD AVE., DETROIT 9, MICH.

For more information, turn to Reader Service Card, Circle No. 382

Exhibits . . .

(continued from page 188)

felt developments are graphically presented, with suggestions and recommendations on felt for every industrial need.

Acadia Synthetic Products Div. features synthetic rubber for special purposes, silicones and plastic sheets. Here ideas are offered on how felt and synthetic rubber can provide greater efficiency and sales-appeal to every type of product.

Westinghouse Electric Corp.
Booth No. 406

The Micarta display features a novel Phono-Mimic presentation of the Micarta story. This "live" demonstration has been designed to tell the designer, engineer and manufacturer about this basic material.

Micarta's wide variety of uses is also demonstrated by a display of fabricated products typical of the materials applications in major industry.

Wisconsin Centrifugal Foundry, Inc.
Booth No. 724

Included in this booth are about 100 various centrifugal castings, ranging in size from 1 in. to 46 in. in dia and in weight from 3 oz to 1600 lbs.

Also shown are parts demonstrating intricate machining operations as well as a working model of a centrifugal casting machine.

Yale & Towne Mfg. Co., Powdered Metal Parts Div.
Booth No. 133

This exhibit shows the advances made in the powdered metal process during the last ten years with respect to various alloys and their physical properties.

The highlight of the booth is a gear train consisting of 100 gears, all operated from a single source of power. All the gears have been fabricated by the powdered metal process at substantial cost savings, which are indicated in the exhibit.

For more information, Circle No. 306

Fast Delivery
ALSIMAG®

DIE PRESSED *Ceramics*

FAST DELIVERY . . . Our own die shop and four modern plants speed deliveries.

LARGE OR SMALL QUANTITIES . . . We have the most complete press facilities in the industry.

ECONOMICAL PRODUCTION . . . The right press for every job permits utmost economy.

ON SPECIFICATION . . . Backed by a reputation for accurate compliance with specifications for more than half a century.

WIDEST CHOICE OF MATERIALS . . . AlSiMag property chart gives more compositions and more physical data than any other source.

ENGINEERING COOPERATION . . . Send sketch and details of requirements for practical, cost-saving, delivery-expediting suggestions.

53RD YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

A SUBSIDIARY OF MINNESOTA MINING AND MANUFACTURING COMPANY

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SEE OUR DISPLAY

BOOTH NO. 340

BASIC MATERIALS EXPOSITION

The Product Development Show

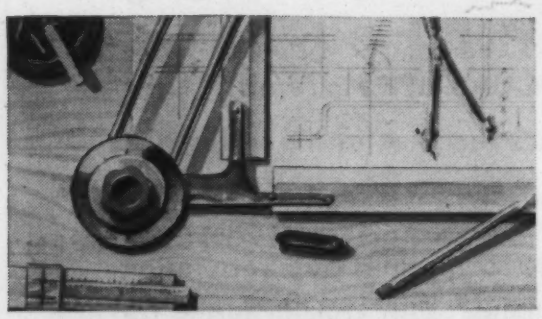
CHICAGO • MAY 17-20, 1954

One or a Million . . .

How expensive are your design ideas?
How accurate are your prototypes?
How quickly can you swing from pilot to production?

Do your design changes run up cost because of prototype "unreliability"? In orders of one or one million, I-S BeCu^{mp} springs measure up to one single standard of performance. This allows you to check your design against production tolerances and tests — without the expense of ordering production quantities. Our "Short-Run" department was set up expressly to handle pilot runs and small production requirements as regular output — instead of treating them as costly "special orders".

I-S Short-Run = Same High Performance – Lower Cost



Two Other Important Advantages

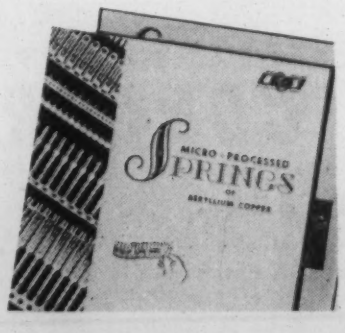
(1) Our ability to produce a better spring faster and usually at a lower cost.

(2) The specialized ability of our engineers to cooperate with your designers in developing your "problem" springs.

Like many other leading manufacturers, you will find that these I-S facilities can make significant improvements in your manufacturing processes and in your product. And they most likely will save you money! One thing is certain . . . it costs nothing to compare — it may cost considerable, *not to!*

The design stage normally poses the basic problems of time and unit costs—plus the uncertainties of performance. By utilizing I-S engineering research and advanced spring-making techniques, you save in testing time and development—as well as in elimination of regular production waste. In addition, you are ready to go into million-plus production, without time-consuming engineering usually involved in the transition from bench-made prototypes to full line production.

For more information on BeCu^{mp} Springs, write today to reserve your copy of our newest catalog—No. 8; for Electronic Components, ask for No. 8-A.



Instrument Specialties Co. Inc.

224-G BERGEN BOULEVARD, LITTLE FALLS, NEW JERSEY

Telephone Little Falls 4-0280

BeCu^{mp} = Beryllium Copper, Micro-Processed

For more information, turn to Reader Service Card, Circle No. 416

About the Speakers

Biographical sketches of the authors of papers read at the Materials Conference.

Carson E. Hawk (Rockets and Guided Missiles—How New Materials for Weapons Can Help Industry)

The author has been associated with the Aerojet-General Corp. since 1942. As the head of the Development Dept., Liquid Engine Div. of the company he now handles the technical direction of that department which has overall responsibility for development of basic components for liquid propellant rocket engines. His position also includes staff engineering responsibilities in materials, controls and electrical categories.

Sam Tour (Corrosion—How to Combat It)

The author, since 1943, has been President and General Manager of Sam Tour & Co., Inc., consulting engineers handling a wide range of problems including corrosion and wear testing, corrosion prevention, metallurgy, metal finishing, chemical processes, mechanics and production.

A licensed Professional Engineer in the State of New York, Mr. Tour is a member of 13 technical societies including the NACE, AIME, the ASM and the ASTM. He holds chairs on a variety of committees of these associations including the Advisory Committee on Corrosion of the ASTM and the Inter Society Corrosion Committee of the NACE.

Since 1916 he has worked as metallurgist and engineer for the U. S. Army Ordnance Dept. and the Doehler Die Casting Co.; has been a consulting metallurgist, chemist and engineer; and has spent three years as Director of the Ordnance Lab., Frankford Arsenal.

Lyle M. Christensen (New Casting Techniques)

The author has been with Northrop Aircraft, Inc. since 1941 as

Another ROCHESTER PRODUCTS

GM STEEL tubing

ENGINEERING ACHIEVEMENT

Automatic Manufacture of Automotive Fuel Lines

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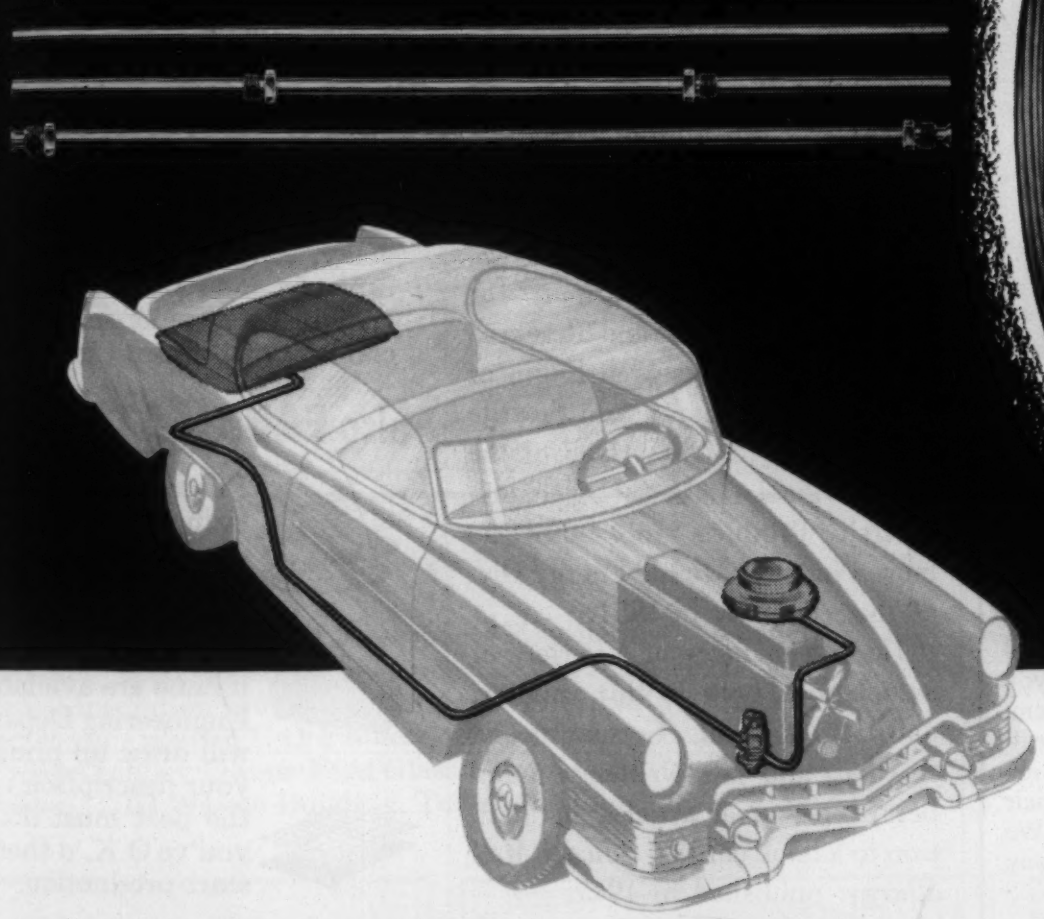

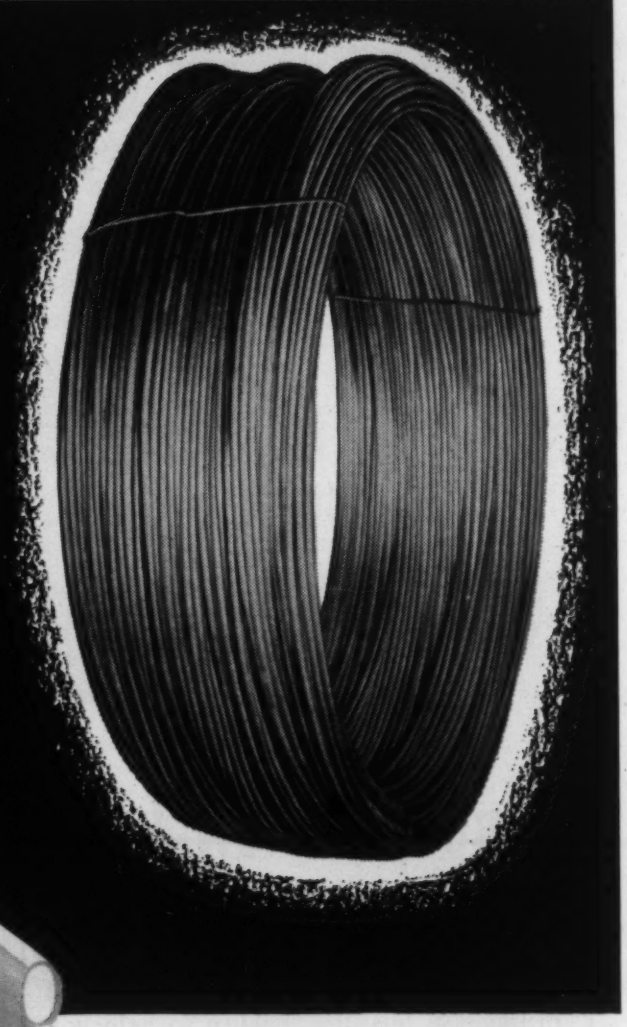

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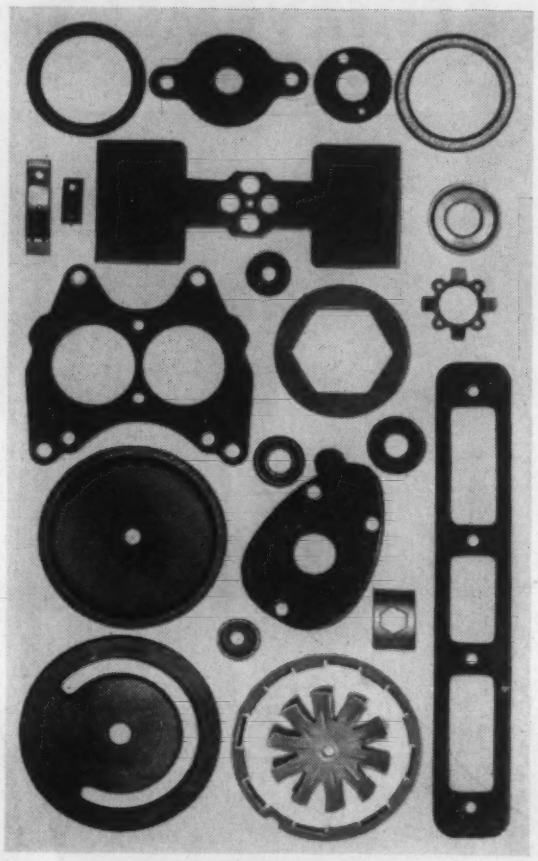

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About the Speakers

(continued from page 194)

Wing Group Structural Designer, Salvage Liaison Engineer and, for the past 6 years, Casting Design Consultant.

Mr. Christensen attended the University of Idaho, Southern Branch and worked with the Power Plant Group at Ryan before joining Northrop.

Dr. Henry H. Hausner (Powder Metallurgy)

A licensed Professional Engineer in New York State, the author has been Manager of Engineering, for the Atomic Energy Div., Sylvania Electric Products, Inc. since 1951 as well as serving as Adjunct Professor of Metallurgy at the Polytechnic Institute of Brooklyn.

He has worked as a research engineer in powder metallurgy with the American Electro Metal Corp., as Chief Electrical Engineer for Nichols Engineering and Research Corp., as Chief Research Engineer for General Ceramics and Steatite Co., and was Section Head of the Metallurgical Lab. at Sylvania Electric Products Inc. until he moved into the Atomic Energy Div. of that company in 1951.

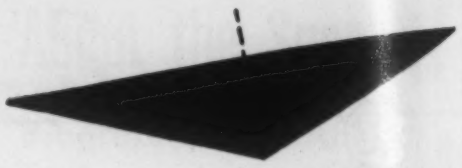
He is a member of a variety of associations both in this country, and in England, Germany and Sweden, and has written a number of technical articles in addition to a book entitled *Powder Metallurgy*, published in 1947.

J. Walter Gulliksen (Forging, Stamping and Extruding)

Since 1942 Mr. Gulliksen has been with Worcester Pressed Steel Co. where he now holds the position of General Superintendent and Member of the Board of Directors.

He is a Registered Professional Engineer, a member of the ASTE, the ASME and past chairman of the Worcester Chapter of the ASM. He has also written a number of technical articles on press-forming of metals.

After taking his M.E. at Stevens Institute of Technology, and do-



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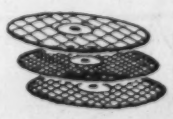

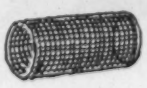

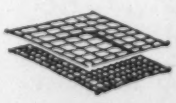

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NEW
High Density Compressed
FIBER·GLASS

To help you soften impact, or absorb vibration

L·O·F announces a new, high-density, fibrous glass material with a wide range of applications. Can be used in sheets or formed to make safety pads, housings and other shapes.

L·O·F High Density Compressed Fiber·Glass offers the following advantages:—

1. Absorbs and reacts to impact more slowly than other materials; affords extremely effective shock protection.
2. Absorbs vibration-borne sound.
3. Excellent thermal insulation in the lower density range.
4. The glass fibers will not burn, mildew, rot, absorb moisture or odors, or support fungi.

High Density Compressed Fiber·Glass is now being used in the following design applications:—

For impact absorption—in automobile safety pads and arm rests.

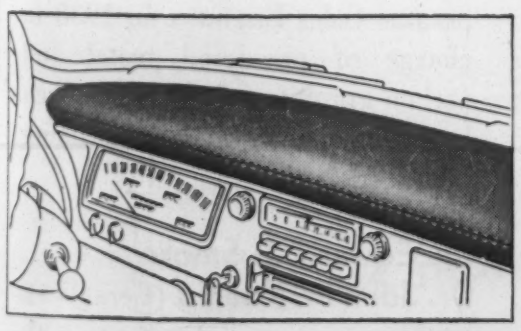
To absorb vibration—to form blower housings and intake deflectors in air conditioners; for automobile roof liner.

For thermal insulation—plus vibration absorption, as a low-cost breaker strip between metal panels.

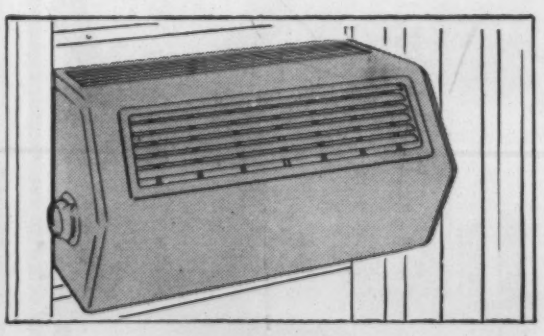
In making High Density Compressed Fiber·Glass, Super·Fine is cured under heat and pressure. Densities vary from 3 lbs. to 50 lbs. per cubic foot. Housings and other shapes can be molded at the Libbey·Owens·Ford plant in Parkersburg, W. Va.

High Density Compressed Fiber·Glass may be just the material you need to solve an impact-, vibration-noise or thermal-insulation problem. For further information, please contact your nearest L·O·F office (offices in 26 major cities). Or write: Libbey·Owens·Ford Glass Company, Fiber·Glass Division, 3754 Wayne Building, Toledo 3, Ohio.

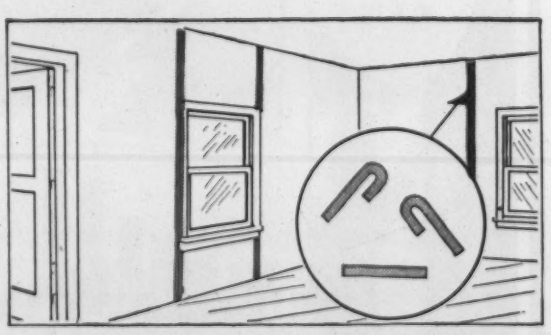
Hi, Mr. Designer! How can YOU put me to work?



In this safety pad, molded from High Density Compressed Fiber·Glass, the leading edge (where impact could be expected) is made softer than the rest of the pad.



This blower housing for an air conditioner, made of High Density Compressed Fiber·Glass, absorbs vibrational noises; helps to solve one of the chief problems in air-conditioning design.



High Density Compressed Fiber·Glass is specified as a low-cost breaker strip between panels in prefabricated steel homes, serving as weather seal, thermal insulation and vibration absorber.

*High Density Compressed Fiber·Glass

L·O·F GLASS Corrulux FIBER·GLASS

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About the Speakers

(continued from page 196)

ing postgraduate work at New York University, he spent approximately 16 years with the Aluminum Co. of America specializing in press work.

Dr. Jesse H. Day (Plastics)

Dr. Day has been closely associated with the SPE since 1944 and for the past 9 years has been editor of the SPE Journal. He has also held an associate professorship in chemistry at Ohio University since 1948.

He received his B.A. degree from Reed College, and his Ph.D. in 1948 from Case Institute of Technology. He has worked as research chemist for U.S. Rubber Reserve and Glenn L. Martin.

Dr. Day is a member of the ACS, the Ohio Academy of Science, and the SPE.

Fremont F. Ruhl (Carbon and Graphite)

Mr. Ruhl has been Sales and Advertising Manager of Gramix and Graphitar products for the U.S. Graphite Co. since 1948.

He received his B.S. in Chemical Engineering from the Michigan College of Mining and Technology and worked as Chemist for General Foods Corp. in their Product Control Lab. from 1935 to 1937.

After joining U.S. Graphite he became Sales Engineer in 1938 in charge of powdered metal and carbon-graphite until 1948 when he became Sales and Advertising Manager.

Dr. Edward J. Smoke
Dr. John H. Koenig (Ceramics)

These two co-authors are both currently with the School of Ceramics at Rutgers University. Dr. Koenig is Director of the school, while Dr. Smoke is Research Professor. Both have had years of experience with industry in research and development in this field.

Dr. Koenig received his Ph.D. from Ohio State University and

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About the Speakers

(continued from page 198)

has served as Research Ceramic Engineer for both General Electric Co. and Hall of China. He has been connected with Rutgers' School of Ceramics since 1945.

Dr. Smoke received his degree from Rutgers in 1929 and spent 8 years with National Ceramic Co. as Ceramics Engineer. After leaving that company he joined the School of Ceramics and has been engaged in ceramic research and development in conjunction with his teaching.

William H. McKnight (Glass)

Mr. McKnight has been on the research and engineering staffs of the Corning Glass Works since 1948 and now holds the position of Supervisor of Development Engineering for that company.

After receiving an M.E. degree in 1934 from the Newark College of Engineering, the author spent the next five years in the design end of the automotive industry. During the war he worked on the first synthetic rubber pilot plant.

At the close of the war he held the position of Engineer of Manufacture for the Federal Telephone and Radio Co., and for the ensuing two years worked with CBS in the development of long playing records.

Dr. J. H. Faull, Jr. (Rubber)

The author is presently a consultant on elastomer research and development to the Office of Naval Research, and to industry.

He received his Ph.D. in Physical Chemistry at Harvard in 1932, and has been, from time to time, a member of government and industry committees on elastomer research and development problems.

He has also been in charge of the Scientific Section, Boston Branch Office of the ONR; member of the Advisory Research and Development Committee for the Office of Synthetic Rubber of the RFC; Director of Research of the General Latex & Chemical Co.;

(Continued on page 224)

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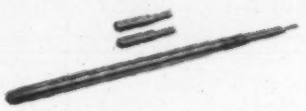

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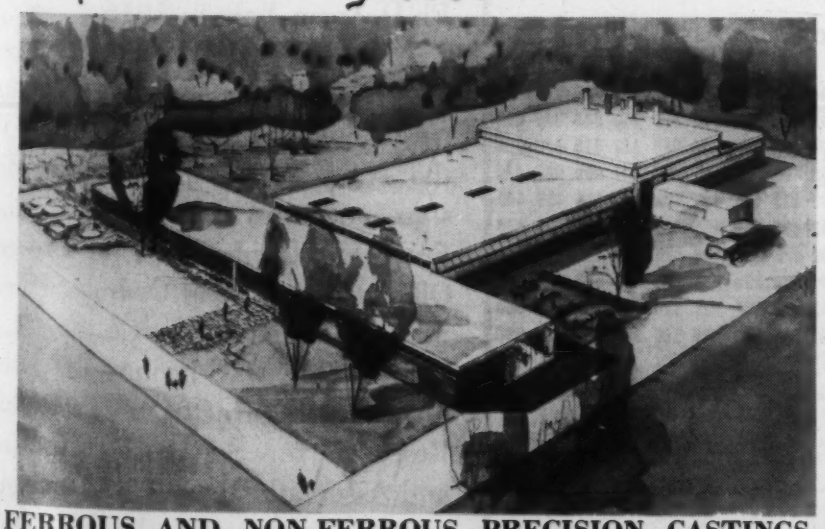

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Program Section
May, 1954

About the Speakers

(continued from page 202)

Technical Superintendent of the GR-S Synthetic Rubber Plant of the General Tire & Rubber Co. and has done research work in the field of Latex for Firestone Tire & Rubber Co.

George Epstein (Adhesive Bonding of Metals and Plastics)

The author is Assistant Supervisor of the Plastics Unit at the Aerophysics Dept. of North American Aviation. He is responsible for the development of two high temperature-resistant structural adhesives currently being employed by that company in guided missile construction

Mr. Epstein served as a member of the panel on adhesives at the USAF-AIA Conference on Adhesives and Sandwich Construction held in 1952 in Dayton, Ohio and is the author of a book on adhesive bonding of metals being published by Reinhold Publishing Corp.

Dr. Merritt A. Williamson (How to Set Up and Operate a Materials Department)

The author has been Director of Research at the Burroughs Corp. since 1952. He was awarded his M.B.A. degree from the University of Chicago in 1953. He had previously received a B.E. in 1938 and an M.S. in metallurgy in 1940 from Yale, an M.S. degree in aeronautics in 1945 from the California Institute of Technology, and a Ph.D. from Yale in 1946.

Prior to World War II he worked as a metallurgist in private industry, followed by over two years in the Navy working on rocket design, materials specifications, and finally as Guided Missile Project Officer at the Naval Ordnance Test Station, China Lake, Calif.

Since the war he has held the position of Director of Technical Research for Solar Aircraft Co., and Associate Director of Development in charge of the Materials Dept. with the Pullman-Standard Car Mfg. Co. until 1952 when he joined the Burroughs Corp.

Materials Engineering File Facts

MATERIALS & METHODS
May • 1954
Number 274

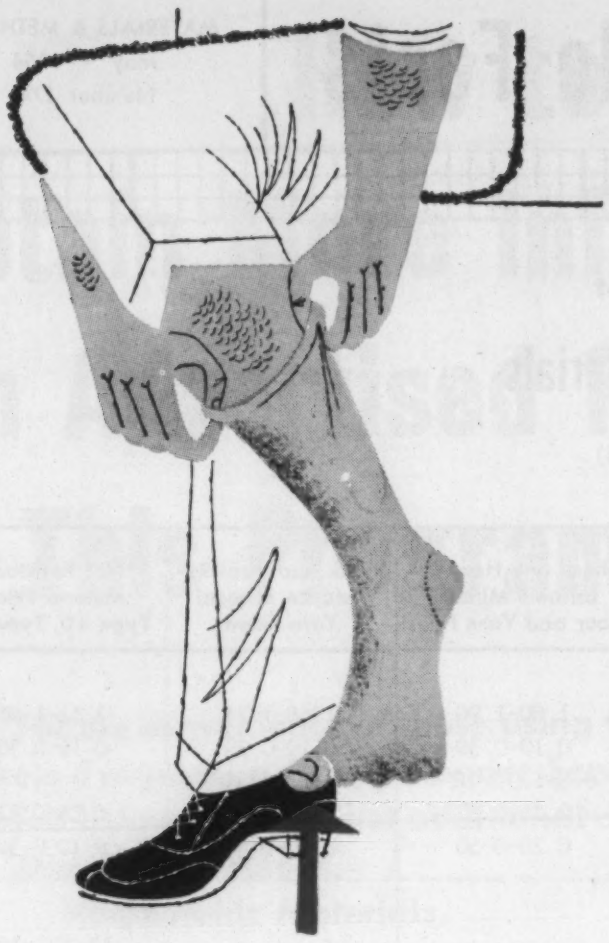
Materials Data Sheet

Phenolic Molding Materials

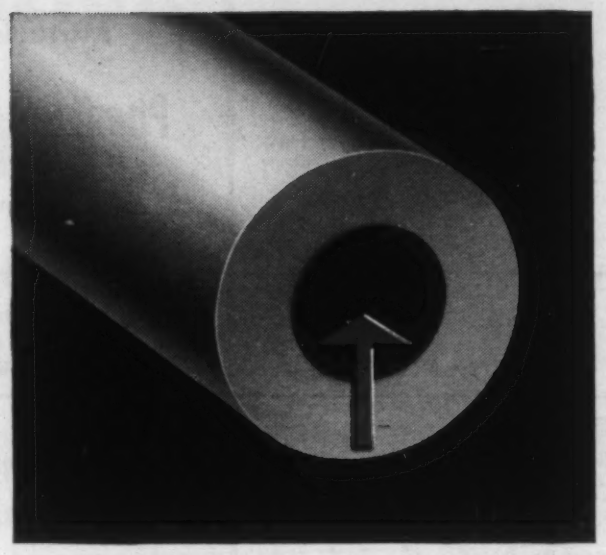
(Continued from April 1954)

Type	ASTM Test Method	Shock and Heat Resistance Mineral Fiber Filled Type 9	Shock and Heat Resistance Mineral Flour and Yarn Filled	Shock and Heat Resistance Mineral Yarn Filled	Heat Resistance Mineral Filled Type 10, Type 13
PHYSICAL PROPERTIES					
Specific Gravity	D792	1.80–2.00	1.80–1.90	1.68–1.74	1.52–1.98
Thermal Cond, Btu/Hr/Sq Ft/Ft/F	C177	0.19–0.39	0.19–0.39	0.19–0.39	0.19–0.39
Coef of Exp per F	D696	$0.8–1.0 \times 10^{-5}$	$0.8–1.0 \times 10^{-5}$	$0.8–1.0 \times 10^{-5}$	1.2×10^{-5}
Specific Heat Btu/Lb/F	—	0.28–0.32	0.28–0.32	0.28–0.32	0.28–0.32
Water Absorption, 24 hr, %	L570	0.10–0.24	0.20–0.50	0.20–0.50	0.10–0.30
MECHANICAL PROPERTIES					
Mod of Elast in Tension, Psi	D638	$15–25 \times 10^5$	—	—	$10–20 \times 10^5$
Tensile Str, Psi	D651	4,000–7,000	5,000–7,000	5,000–7,500	4,000–6,000
Hardness, Rockwell	D785	M100–110	M110	M110	M95–115
Impact Str, Izod Notched (Ft-Lb per in. of notch)	D256	0.34–1.0	1.0–2.0	2.0–3.5	0.23–0.42
Mod of Elast in Flexure, Psi	D790	$15–25 \times 10^5$	$10–20 \times 10^5$	$10–20 \times 10^5$	$10–20 \times 10^5$
Flexural Str, Psi	D790	7,000–12,000	8,000–10,000	10,000–15,000	6,000–10,000
Compressive Str, Psi	D695	15,000–25,000	15,000–25,000	15,000–25,000	15,000–35,000
ELECTRICAL PROPERTIES					
Elect Res, Ohm-Cm (Volume)	D257	$0.1–10 \times 10^{11}$	$1–5 \times 10^{11}$	$1–5 \times 10^{11}$	$1–5 \times 10^{11}$
Dielectric Str (Short Time) Volts/mil	D149	150–250	100–150	100–150	150–350
Dielectric Constant					
60 Cycles	D150	30–70	100–150	100–150	5.8–40
1,000,000 Cycles	D150	5.0–7.0	5.0–7.0	5.0–7.0	4.8–8.0
Loss Factor					
60 Cycles	D150	9.0–35	25–75	25–75	0.6–14
1,000,000 Cycles	D150	0.5–1.8	1.3–3.5	1.3–3.5	0.2–1.2
FABRICATING PROPERTIES					
Compression Ratio (Bulk Factor)		3–12.5	9–14	9–14	2–3
Compression Molding Temp, F	D958	290–380	290–380	290–380	290–380
Compression Molding Pressure, Psi	D833	2,000–6,000	2,000–6,000	2,000–6,000	2,000–6,000
Transfer Molding Temp, F	D958	275–325	275–325	275–325	275–325
Transfer Molding Pressure, Psi	D833	2,000–12,000	2,000–12,000	2,000–12,000	2,000–10,000
MAX RECOMMENDED SERVICE TEMPERATURE, F		350–425	350–400	350–400	350–450
CORROSION RESISTANCE		Severely attacked by strong acids and strong alkalies. Effects of dilute acids, alkalies and organic solvents varies with the reagent. Chemical resistance varies with the particular formulation and not all materials of a type are equally resistant.			
USES		Mechanical applications include, pulleys, wheels, motor housings, handles; electrical uses include coil forms, ignition parts, condenser housings, fuse blocks, instrument panels; thermal applications include handles and appliance connector plugs; chemical uses include photographic development tanks, rayon spinning buckets and parts, milking machine cups; decorative applications include radio and television cabinets, handles, knobs, buttons.			

(Continued on page 227)



a hole here is a nuisance...



a hole here is an advantage

Crucible Hollow Tool Steel Bars are saving time and money for more and more members of the metalworking industry. By using these hollow bars you eliminate drilling and boring operations, increase machine capacity and cut scrap losses.

Now, you can get hollow bars of any of Crucible's famous tool steel grades, in almost any combination of O.D. and I.D. sizes. And you can get *immediate* delivery of five popular grades from your local Crucible warehouse—KETOS® oil-hardening, SANDERSON® water-hardening, AIRDI 150® high carbon—high chromium, AIRKOOL® air-hardening, and NU DIE V® hot-work tool steels.

Your Crucible representative can point out ways to save time and money by using Crucible Hollow Tool Steel Bars.

CRUCIBLE first name in special purpose steels

54 years of Fine steelmaking

HOLLOW TOOL STEEL

CRUCIBLE STEEL COMPANY OF AMERICA • TOOL STEEL SALES • SYRACUSE, N. Y.

For more information, turn to Reader Service Card, Circle No. 383

Phenolic Molding Materials (Continued)

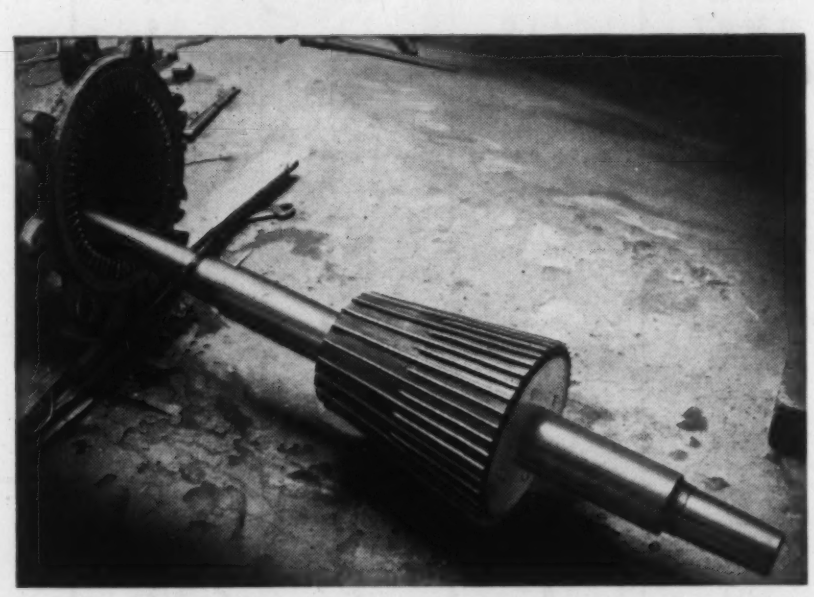
Type	ASTM Test Method	Chemical Resistance	Rubber Phenolic Wood Flour Filled	Rubber Phenolic Cotton Flock Filled	Rubber Phenolic Chopped Fabric Filled	Rubber Phenolic Asbestos Filled
PHYSICAL PROPERTIES						
Specific Gravity	D792	1.24–1.90	1.24–1.34	1.24–1.35	1.30–1.35	1.60–1.65
Thermal Cond, Btu/Hr/Sq Ft/Ft/F	C177	—	0.12	0.12	0.05	0.04
Coef of Exp per F	D696	2.2×10^{-5}	0.8×10^{-5}	1.2×10^{-5}	1.7×10^{-5}	2.2×10^{-5}
Specific Heat Btu/Lb/F	—	—	—	—	—	—
Water Absorption, 24 hr, %	L570	0.15–0.60	0.50–1.0	0.50–1.0	0.50–1.0	0.10–0.25
MECHANICAL PROPERTIES						
Mod of Elast in Tension, Psi	D638	$7–15 \times 10^5$	$4–6 \times 10^5$	$4–6 \times 10^5$	—	—
Tensile Str, Psi	D651	5000–8000	4500–7000	4500–9000	3500	4000
Hardness, Rockwell	D785	M105–120	M50–85	M55–90	M57	M50
Impact Str, Izod Notched (Ft-Lb per in. of notch)	D256	0.2–0.6	0.34–0.7	0.4–1.0	2.3	0.4
Mod of Elast in Flexure, Psi	D790	$7–15 \times 10^5$	$4–6 \times 10^5$	$4–6 \times 10^5$	3.5×10^5	5×10^5
Flexural Str, Psi	D790	7000–12,000	7000–10,000	8000–12,000	7000	7000
Compressive Str, Psi	D695	18,000–30,000	16,000–20,000	15,000–20,000	15,000	16,000
ELECTRICAL PROPERTIES						
Elect Res, Ohm-Cm (Volume)	D257	$0.5–10 \times 10^{11}$	$10^6–10^{11}$	$10^7–10^{11}$	10^8	2.5×10^8
Dielectric Str (Short Time) Volts/mil	D149	225–275	250–350	300–375	250	350
Dielectric Constant						
60 Cycles	D150	10–15	8–15	8–16	15	15
1,000,000 Cycles	D150	5.5–7.0	5–6	5–6	5	5
Loss Factor						
60 Cycles	D150	1.5–3.8	6–11	3.2–10	7.5	2.3
1,000,000 Cycles	D150	0.2–0.6	0.4–0.9	0.5–1.2	0.45	0.65
FABRICATING PROPERTIES						
Compression Ratio (Bulk Factor)		1.94	3.5	4	8	2.5
Compression Molding Temp, F	D958	300–360	300–350	300–350	300–350	300–350
Compression Molding Pressure, Psi	D833	2000–6000	2000–6000	2000–6000	2000–6000	2000–6000
Transfer Molding Temp, F	D958	275–340	300–350	300–350	300–350	300–350
Transfer Molding Pressure, Psi	D833	2000–10,000	2000–12,000	2000–12,000	2000–12,000	2000–12,000
MAX RECOMMENDED SERVICE TEMPERATURE, F		300–425	212–300	212–300	212–225	250–260
CORROSION RESISTANCE		Severely attacked by strong acids and strong alkalies. Effects of dilute acids, alkalies and organic solvents varies with the reagent. Chemical resistance varies with the particular formulation and not all mater ials of a type are equally resistant.				
USES		Mechanical applications include pulleys, wheels, motor housings, handles; electrical uses include coil forms, ignition parts, condenser housings, fuse blocks, instrument panels; thermal applications include handles and appliance connector plugs; chemical uses include photographic development tanks, rayon spinning buckets and parts, milking machine cups; decorative applications include radio and television cabinets, handles, knobs, buttons.				

Prepared with the assistance of the Manufacturing Chemists' Association, Inc.

Based on the Chemists' Association publication "Technical Data on Plastic", 1952

Cast for the role of resisting wear

"S" Monel Sleeves



Six advantages of Inco Castings

1. You get castings that generally outlast other materials under destructive service conditions. That's because they are made of Inco Nickel Alloys, which have been especially developed to withstand corrosion, abrasion, erosion and galling.
2. You get high quality castings because they are made to meet or exceed Government specifications for these high Nickel alloys.
3. You get castings in any practical design or size you need including centrifugal castings and standard pipe fittings. Inco has specialized in castings for over 47 years and is equipped to make your castings whether they weigh a few ounces or tons.
4. You get the benefit of Inco's help in solving your metal problems based on wide experience in field and laboratory testing of Nickel Alloys.
5. You get Inco Nickel Alloy castings made at Inco's own foundry; your assurance of sound, dependable castings.
6. Even castings you previously thought impractical to produce in Monel®, Nickel or Inconel® can often be cast by Inco's specialists.

How often have you wished you could get a wearing sleeve that would resist destructive conditions like abrasion and corrosion? Then take a look at these two sleeves.

The "S"® Monel sleeve pictured at top goes on the shaft of a salt water circulating pump.

Severe abrasion and corrosion from the sandy salt water in the gland seals used to wear out shaft sleeves in these pumps every 2½ years. Usually sooner.

Then the engineers decided to try Inco-Cast "S" Monel sleeves. *These sleeves have already withstood this abrasive and corrosive attack for nearly five years!*

Pictured in the second photo is the rotor-shaft-sleeve assembly for a midget Jordan machine. This machine processes highly abrasive raw asbestos. Ordinary sleeves were lasting only 15 months.

Then centrifugally-cast "S" Monel sleeves were tried. Judging from their appearance after more than a year's service, their owners estimate these sleeves will give "*ten times as much service*".

Unusual service like this is common when "S" Monel is used. Field records show it generally gives from three to ten times longer life than ordinary materials where service conditions involve destructive abrasion, corrosion, galling, or erosion.

Do you want to know more about this age-hardenable, corrosion-resisting casting alloy? Data on its composition, properties, and working instructions are summarized in a new bulletin, "Engineering Properties of 'S' Monel." Write for a copy today.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Castings Sand, Centrifugal, Precision

For more information, turn to Reader Service Card, Circle No. 481

Materials Engineering File Facts

MATERIALS & METHODS
May • 1954
Number 275

Materials Data Sheet

Uranium and Thorium

	Uranium	Thorium
PHYSICAL PROPERTIES		
Density, Lb/Cu In.	0.69	0.42
Melting Point, F	2071	3074
Thermal Cond, Btu/Hr/Sq Ft/Ft/ F @ 70 F	14.5	21.4
Coef of Exp per F:	12.1×10^{-6} [a]	6.2×10^{-6} [b]
Spec Heat, Btu/Lb/F:	0.03	0.03
Elect Res, Microhm-Cm @ 68 F:	25–50	18
MECHANICAL PROPERTIES		
Mod of Elast in Tension, Psi	30,000,000	10,000,000
Tensile Str, 1000 Psi: Annealed	90	37.5
Yield Str 0.2% offset, 1000 Psi: Annealed	25	27
Elong in 2 In., %: Annealed	13	40
FABRICATING PROPERTIES	Can be forged, rolled, swaged and drawn. Heating must be done in a protective atmosphere.	Can be readily hot or cold worked. Fabricated by forging, rolling, swaging, extruding or drawing.
Machinability	Moderately difficult to machine.	Can be machined like mild steel with or without cutting fluids.
Joining	Can be welded or brazed in protective atmosphere or vacuum.	Difficult to weld, brazing yields brittle joints.
CORROSION RESISTANCE	Very poor resistance to the atmosphere, water and most reagents.	
FORMS	Shapes which have been produced include plate, rod, tube, wire and foil.	Shapes which have been produced include rod, sheet, thin-walled tube, fine wire, foil.
USES	Fissionable material (fuel) in nuclear reactor.	Secondary (breeder) reactor fuel.

[a] *70-250 F for direction parallel to A axis; −0.8 x 10^{-6} parallel to B axis; 12.9 x 10^{-6} parallel to C axis.*
[b] *70 F.*

Send for this new bulletin on

THERMALLOY* FURNACE CONVEYOR BELTS

See how design know-how

and modern foundry practices can produce high alloy

conveyor belts that last longer in heat treating operations

In this new bulletin you will see how Electro-Alloys engineers started with certain design theories about high temperature conveyor belts . . . and how these ideas directed the production of heat-resistant Thermalloy castings. You will see the importance attached to precision assembly of these castings into Thermalloy Conveyor Belts.

Finally, you will be interested to know that Electro-Alloys has established unique testing procedures that will give you a good indication of what can be expected from Thermalloy Conveyor Belts in operation. These results are shown in a composite load curve chart in the bulletin. And, Electro-Alloys engineers can apply these results to your installation... so you can get longer service life from Thermalloy Conveyor Belts in your heat treating furnaces.

Start planning now to use Thermalloy Conveyor Belts to lower operating costs. Write for your free copy of Bulletin T-241 . . . Electro-Alloys Division, 5001 Taylor Street, Elyria, Ohio.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION

Elyria, Ohio

*Reg. U. S. Pat. Off.

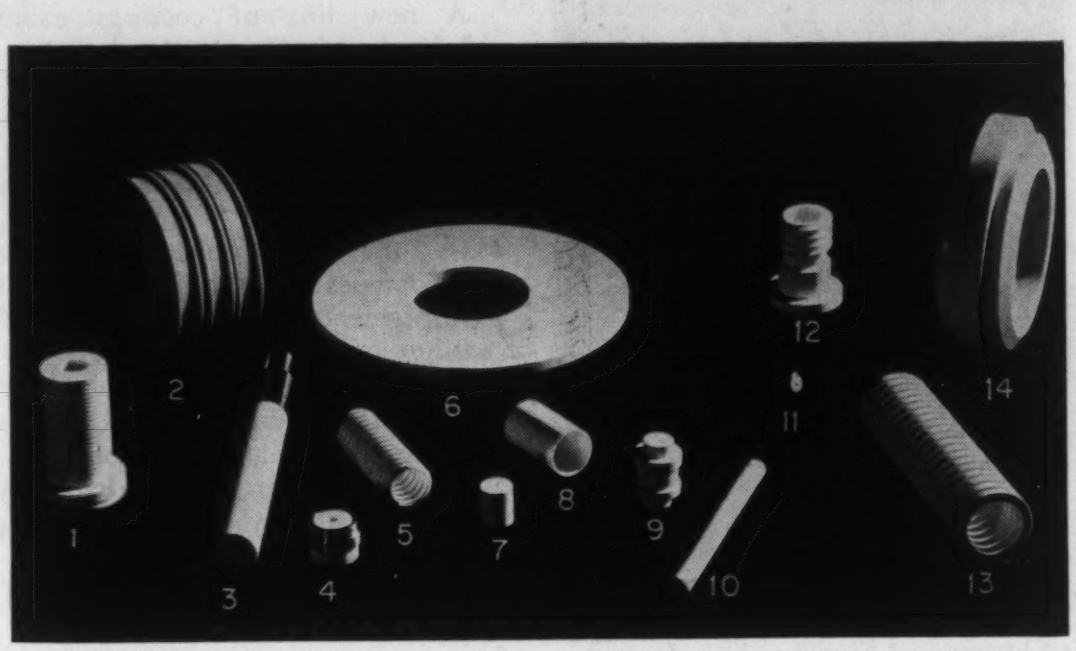
For more information, turn to Reader Service Card, Circle No. 415

New Materials, Parts and Finishes

...and Related Equipment

These Parts . . .

1. Coil Form
2. Ribbon Guide
3. Pump Plunger
4. Extrusion Die
5. Spring
6. Orifice Plate
7. Refractory Post
8. Tubular Capacitor
9. Hydraulic Valve Part
10. Thermocouple Tube
11. Nozzle
12. Threaded Nipple
13. Spring
14. Seal Face



Made With Sintered Aluminum Oxide

A new group of sintered metallic oxides has been developed by the *U. S. Stoneware Co.,* Akron 9, Ohio and is being marketed through their Alite Div. The emphasis is now being laid on their "A" type (aluminum oxide) since this is the material which seems to have the widest variety of applications, according to the company.

Uses for the material are said to range through the chemical industry, electronics, refractory specialties and machine parts.

Properties

Not to be confused with conventional ceramic materials, the aluminum oxide Alites are essentially single phase, crystalline materials virtually free of glass-type bond. Since bonding is achieved by crystal growth across grain boundaries, properties of the sintered materials are said to approach those of single-crystal aluminum oxides of the sapphire type.

One of the main advantages of the materials is the high service temperatures they can withstand—somewhere in the 3000 F range. This makes the material suitable for refractory jigs and supports, and bearings for elevated temperature operation.

In addition, much of the initial research by the company was devoted to the stabilization of the oxide with respect to chemical attack. According to the company, the problem has been adequately solved and Alites intended for chemical service are comparable to chemical porcelains in corrosion resistance.

High dielectric properties, good strength, vacuum tightness and low power factor are properties which suggest the use of the aluminum oxide Alites in the electronics industry, and a high degree of hardness, said to be comparable to corundum or sapphire, makes the material well suited to abrasion and wear resistant applications.

Likened to Powder Metallurgy

The fabrication of Alite parts is somewhat similar to the powder metallurgy process. Purified and sized oxide powders are blended and mixed with binders and lubricants necessary for the die pressing or extruding operations. Larger and more complex shapes are slip cast in plaster molds using a water suspension of oxide powders. Pre-sintering machining operations may be performed using diamond, sapphire or Alite tool bits, and the green parts are then loaded into the sintering furnace.

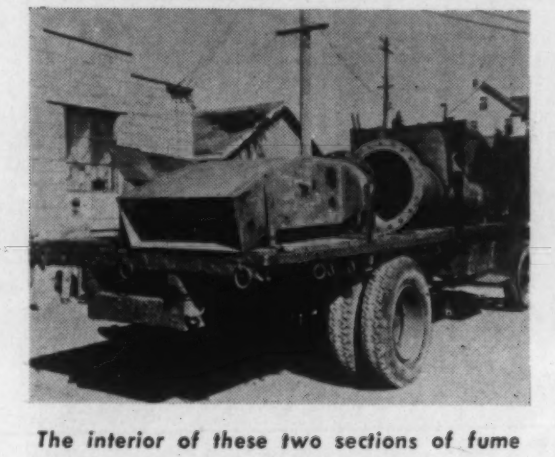
Sintering temperatures for the A type Alites are in the range of 3000 to 3400 F for 1 to 6 hr, followed by rapid cooling to prevent excessive crystal growth.

Physical Properties of "A" Type Alites

Tensile Str, Psi	18,000 – 26,500
Compressive Str, Psi	165,000 – 285,000
Mod of Elasticity, Psi	32×10^6 – 45×10^6
Specific Gravity	3.3 – 3.8
Color	White*
Hardness	Equivalent to sapphire
Thermal Cond at 100 F, Btu/hr/sq ft/F/in.	95 – 133
Specific Heat	0.18 – 0.19
Dielectric Str, V per mil	250 – 300
Dielectric Constant (Imc)	7.8 – 8.5
Power Factor (Imc)	0.002 – 0.0006

** Certain specialized formulations may be colored.*

Vinyl Coatings Resist Abrasion, Corrosion



The interior of these two sections of fume ducts have been coated with the vinyl coating to protect them from corrosive fumes.

A new line of coatings using polyvinyl chloride as the basic ingredient has been developed to protect industrial equipment from abrasion and corrosion.

Produced by the *Magic Chemical Co.*, 121 Crescent St., Brockton 2, Mass., the Magic-Vulc coatings are of two types: 1) Coatings of vinyl resin-pigment-solvent systems and 2) coatings of vinyl plastisol.

The coatings may be applied by brush, spray or dip, on metal, wood, concrete, fabric, and other surfaces. When dry they are said to lengthen equipment life by preventing abrasion and corrosion of the coated material. According to the company the coatings are suitable for protecting tanks, racks, trucks, pipes, fabrics, fans, blowers, etc.

The following advantages are claimed for the coatings:

1. Resist corrosive action of chemicals, mildew, fungi, and tropical seashore climates.
2. Serve as electrical insulators and dielectrics.
3. Flexibility; will not chip or crack on a flexible surface.
4. Easy to clean; may be scrubbed with alkalis.
5. Adherence to a variety of surfaces.
6. Available in a variety of colors.

Phenolic Molding Compound Has Increased Impact Strength

A nitrile rubber bearing phenolic molding compound with improved impact strength has been developed by *Durez Plastics & Chemicals, Inc.*, North Tonawanda, N. Y.

The material, known as 16840, is a black thermosetting resin with a lower modulus of elasticity than materials of similar type, according to the company. The surface finish obtainable is said to be good with higher gloss and less flow lines, and cure time of the compound is slightly shorter.

It is said to be particularly suitable for use in thin sections around inserts and it will absorb shock more readily than standard wood-flour or flock-filled materials. It may be molded either by compression or the plunger method.

Two New Adhesives for Nonmetallics

A self-extinguishing fire resistant laminating adhesive which will withstand continuous heat in the range of 375 F has been developed by *Paisley Products, Inc.*, 630 W. 51 St., New York 19. It is designed for use in adhering glass fiber insulation pads and blankets to sheet metal, aluminum foil, fabrics, wallboard and similar materials.

Called Insulam, the adhesive is a synthetic rubber-like resin emulsion with a quick wet-tack to hold assemblies together until dry. After curing it is said to become water resistant and will not support combustion.

Uses for the material include fastening insulation pads to interior walls of gas ranges, oil heaters, etc.; coverings to furnace pipes; boiler lagging operations; and laminating assemblies of glass fiber to foil, vinyl films and other non-porous surfaces.

Dry Film

Dacar Dri-Bak Adhesive, developed by the *Dacar Chemical Products Co.*, McCartney at Wabash St., West End, Pittsburgh 20, is applied like paint to the sheet or strip and allowed to dry. When dry, the pieces can be packed and shipped without danger of sticking.

When adherence is desired, the user activates the adhesive film by wiping it with solvent just prior to use. Fast grab and full-strength adhesion are claimed by the company for the resulting bond.

It is said to be particularly adapted for use on sponge rubber, weatherstripping, etc., for application to metal, glass, wood and other surfaces. High bond strength is said to be retained at elevated temperatures.

Silicone Rubber Vulcanizes At Room Temperature

Neither heat, pressure nor full exposure to air is required to cure sections up to 1/8 in. thick of RTV Silastic, a new silicone rubber developed by *Dow Corning Corp.*, Midland, Mich. The new material is said to develop the high and low temperature stability, water repellency, and chemical resistance characteristics of silicone rubber within 24 hr after application.

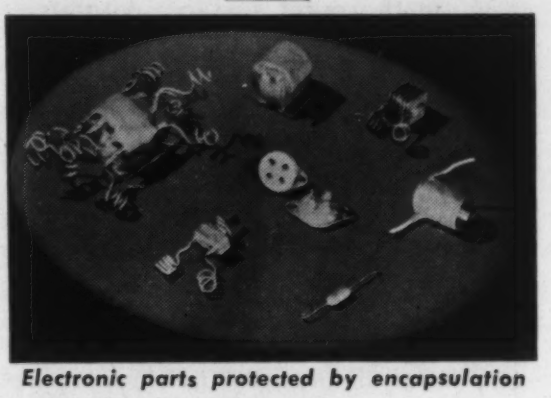
Thicker sections, up to 1 in., may be cured under pressure up to 50 psi, and curing time can be shortened if heat is applied after the rubber has set.

Typical properties for a 1/8-in. section are:

Durometer, Shore A	15-30
Tensile Str., Psi	130-500
Elongation, %	300-600
Moisture Absorption, 7 days at 70%, %	1-2
Dielectric Str., Vmp	350-550
Dielectric Constant, 100 cycles	3.2-3.4
1 megacycle	3.0-3.2
Power Factor 100 cycles	0.015-0.30
1 megacycle	0.005-0.01

The material is available in several solvent-free consistencies, ranging from fluid enough to flow under its own weight to heavy enough to require milling. It is shipped and stored in the form of two separate components, each containing a catalyst. When the components are mixed in equal parts by weight they react to form a non-heat vulcanizing system. The material sets in approximately 4 hr, cures in 24 hr, and develops optimum properties in 4 to 7 days.

Suggested uses for RTV Silastic include cloth coating dope, caulking, glazing and sealing material, potting and encapsulating compound for electric and electronic assemblies and casting compound for flexible molds.



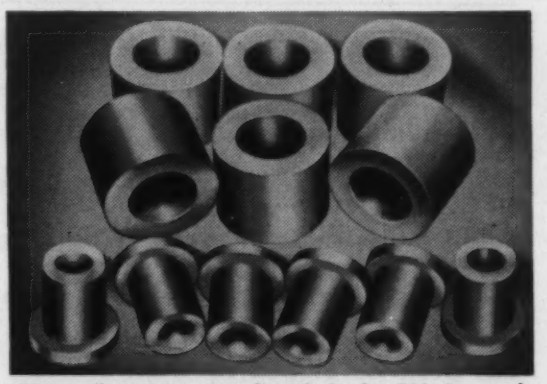
Electronic parts protected by encapsulation in the new silicone rubber.

New Bearing Compound

Teflon, glass, graphite and an inert lubricant are joined in a new bearing compound for use in operations where the material is exposed to corrosive action.

Developed by *Chemical & Power Products, Inc.*, 11 Broadway, New York 9, the material, called Style FM-4, is said to be used in bearings on submerged pumps and as a tail shaft bearing on vertical mixers and reactors where an inert material is needed.

It is easily machinable and can be used in low speed operations without lubrication.



These bearings made of Style FM-4 need no lubrication at low speeds.

Long Wear Life Claimed for New Chromium-Iron Alloy

A new wear hardening chromium-iron casting alloy with long life under highly abrasive conditions has been developed by the *Calumet Steel Castings Corp.*, 1636 Summer St., Hammond, Ind.

According to the company, the alloy, called ZeVeScal, work hardens to Brinell values of around 700 on the wear surface. Ultimate properties of the material are gained by a precipitation hardening treatment which develops coalesced carbides in a retained austenitic phase. The microstructure consists of carbides of chromium, molybdenum and iron in a matrix of austenite. The wear resistance is said to stem from the close proximity of the carbides and also from the work hardening of the austenite.

The material is said to be suitable for paddles in Pug Mills, gravel mixers, and other types of service.

New Materials, Parts and Finishes continued

Two New Resins: Foam and Casting

A new series of low density, unicellular, thermosetting plastic foam materials with a range of bulk densities has been developed by *Emerson & Cuming, Inc.,* 869 Washington St., Canton, Mass.

Called Eccofoam, the material is readily machinable and has a thin skin on the outer surface. Although properties of the material vary with bulk density, at 10 lb per cu ft the material possesses the following values: dielectric constant at 10^4 to 10^{10} cps, 1.18; dissipation factor at 10^{10} cps, 0.0004; tensile strength, 320 psi; compressive strength, 340 psi; modulus of elasticity, 11,000 psi; thermal conductivity, 0.02 Btu per hr per sq ft per degree F per ft.; water absorption, 0.25% gain in 24 hrs at 77 F on 8 cu in. sample.

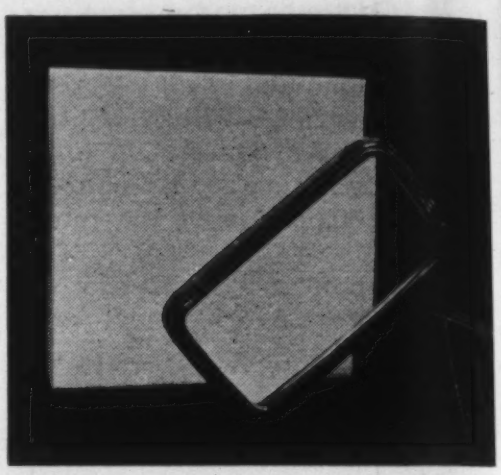
The Eccofoam plastics are available in sheets 30 by 18 in. with thicknesses of 1, 2 or 3 in., though other sizes and shapes may be had on special order.

Low-Loss Casting Resin

The same company has also developed a new casting resin, Stycast TPM, with low loss, and a low dielectric constant. It is a thermosetting plastic and is said to be useable over a wide range of temperatures.

With frequencies of from 60 to 10^{10} cps, the dielectric constant range of the cured resin is from 2.36 to 2.38 while the dissipation factor is below 0.0009. Dielectric strength is 450 v per mil and volume resistivity is above 10^{13} ohms-cm^3.

Physical properties of the cured material are: specific gravity, 1.05; tensile strength, 5000 psi; flexural strength, 7000 psi; compressive strength, 8000 psi; modulus of elasticity, 3.0 x 10^5 psi; izod impact, 2 ft-lbs per in. of notch; hardness, Rm 50; water absorption, 0.5% gain at 77 F in 24 hrs; temperature range, —94 to 257 F; color, opaque white; and machinability, good.



A range of bulk densities is available in this thermosetting foam plastic.

Safe Compound for Steam Cleaning

A new cleaning material, Oakite Composition No. 93, designed for use in steam-generating equipment and in steam guns where the solution is siphoned from an auxiliary tank, has been developed by *Oakite Products, Inc.,* 132H Rector St., N. Y. 6.

The material is a white, free-flowing powder which is soluble in water and is said to possess a high sequestering ability. According to the company, when added to water of up to 20 grains hardness, it will show no precipitate or turbidity.

Normal working concentrations range between ¼ and 4 oz per gal of water. Solutions are non-toxic and safe for steam gun operators. The material is said to be approved by the U. S. General Services Administration, and to appear on the qualified products list as meeting Federal Specification—Steam Cleaner—P-S-00751 (G.S.A.—F.S.S.).

New Aluminum Alloy Has High Strength

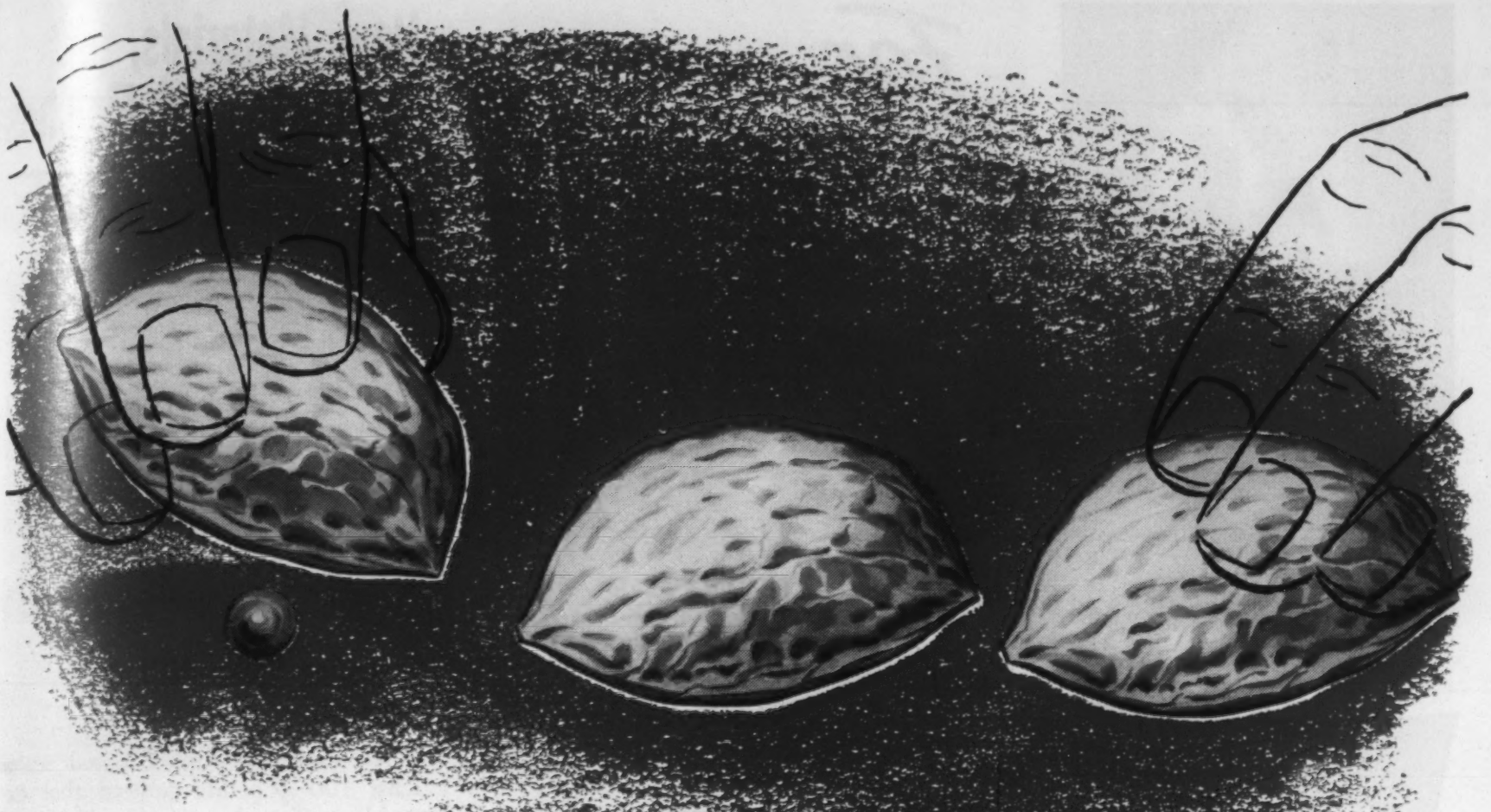
A new aluminum alloy designated HZM 100 is said to have shown typical ultimate tensile strengths of around 100,000 psi.

Developed by the *Harvey Machine Co., Inc.,* 190th St. & Western Ave., Torrance, Calif., the alloy is said to have a ductility similar to that of alloy 75S, guaranteed elongation in all thicknesses being 7%. Tolerances and other data relative to productibility are the same as those quoted for 75S, although the price is at present a bit higher.

The guaranteed mechanical properties of the new alloy in the T6 condition are as follows:

Section Thickness, In.	Tensile Str, Psi	Yield Str, Psi
Up to .249	89,000	82,000
.250 to .749	92,000	84,000
.750 to 2.999	90,000	84,000

(Continued on page 236)



THEY MAY LOOK ALIKE

...but there's a big difference underneath

And it's the same way in buying carbon or alloy steel tubing. Lots of it looks very much like OSTUCO . . . but underneath it all there are these advantages that save you money:

OSTUCO provides a single source service . . . complete manufacturing, fabricating and forging operations under one roof mean one purchase order takes care of all details. And you can depend on deliveries as promised. OSTUCO'S flexibility assures the same efficiency and economy in both large or small production runs. OSTUCO'S quality control maintains uniformity of structure from raw materials to finished product.

The complete story as outlined in an informative booklet, "OSTUCO Tubing," is yours for the asking. Or better still—for conclusive proof—send us your blueprints for prompt quotation.

OSTUCO SHELBY, OHIO **OSTUCO TUBING**

SEAMLESS AND ELECTRIC WELDED STEEL TUBING
—Fabricating and Forging

OHIO SEAMLESS TUBE DIVISION
of Copperweld Steel Company • **SHELBY, OHIO**
Birthplace of the Seamless Steel Tube Industry in America

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CANADA, RAILWAY & POWER CORP., LTD.
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117 Liberty Street, New York 6, New York

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And real production economy sense, too!

The old axiom about "the chain and its weakest link" still holds true. It takes *top quality parts, all the way*, to economically produce dependable equipment. Today's market *demands* it . . . and your product rating *depends* on it! It makes sense!

Unitcast pours a *complete range* of *top quality* carbon and alloy steel castings up to 150,000 pound tensile strength. No matter what the end use . . . or whether your needs are twenty or twenty-thousand, Unitcast will deliver *top quality all the way!* Unitcastings, delivered in coordination with your production make sense! Call today!

Take advantage of Unitcast's foundry engineering services, too! Experienced technicians will help you originate . . . or convert present requirements to Unitcastings. No obligation, ask about this service!

UNITCAST CORPORATION • Toledo 9, Ohio

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Unitcast QUALITY STEEL CASTINGS

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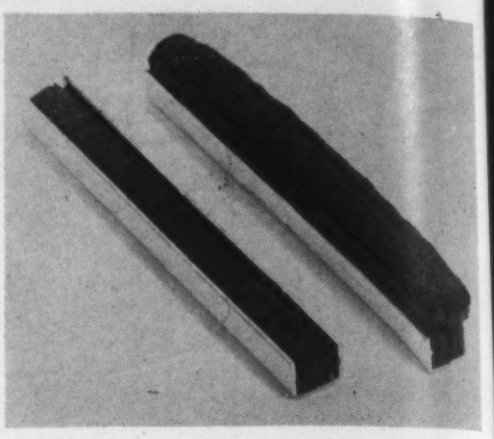
New Materials, Parts and Finishes



Expanding Sealer Fills Gaps Uniformly

An extruded rubber based sealer with 100% solids content that expands uniformly over the length of the sealer bead when heat-cured has been developed by the *Adhesives and Coatings Div., Minnesota Mining and Manufacturing Co.,* 423 Piquette Ave., Detroit 2.

Applied in the form of a flexible rubber strip, EC-1209 sealer cures and expands when heated to form a gasket-like material between metal surfaces. It is said to seal out water, dust and dirt and to act as a cushion to prevent rattles and squeaks.

Features claimed for the new sealer are:

1. It can be used to seal seams which are not uniform in width since it expands to fill the gap.
2. Special flow or pressure application equipment is unnecessary.
3. Application and processing time is reduced since no time is required for solvent evaporation.
4. Waste of material is reduced.
5. Large gaps can be filled without the sealer flowing out from behind the metal.

Controlled Expansion

The amount of volume increase depends on the time and temperature used in the curing process: 40 min at 250 F will produce a swell of 70 to 80%, while a 15 min cure at 350 F will cause swelling of around 125%. Once cured, the sealer is said to remain flexible to about —20 F and will provide continual service at temperatures up to 150 F. It will withstand temperatures up to 300 F for short periods of time without deteriorating and flowing.

Heat expanding sealers are finding

It's welded... but you can't feel the weld

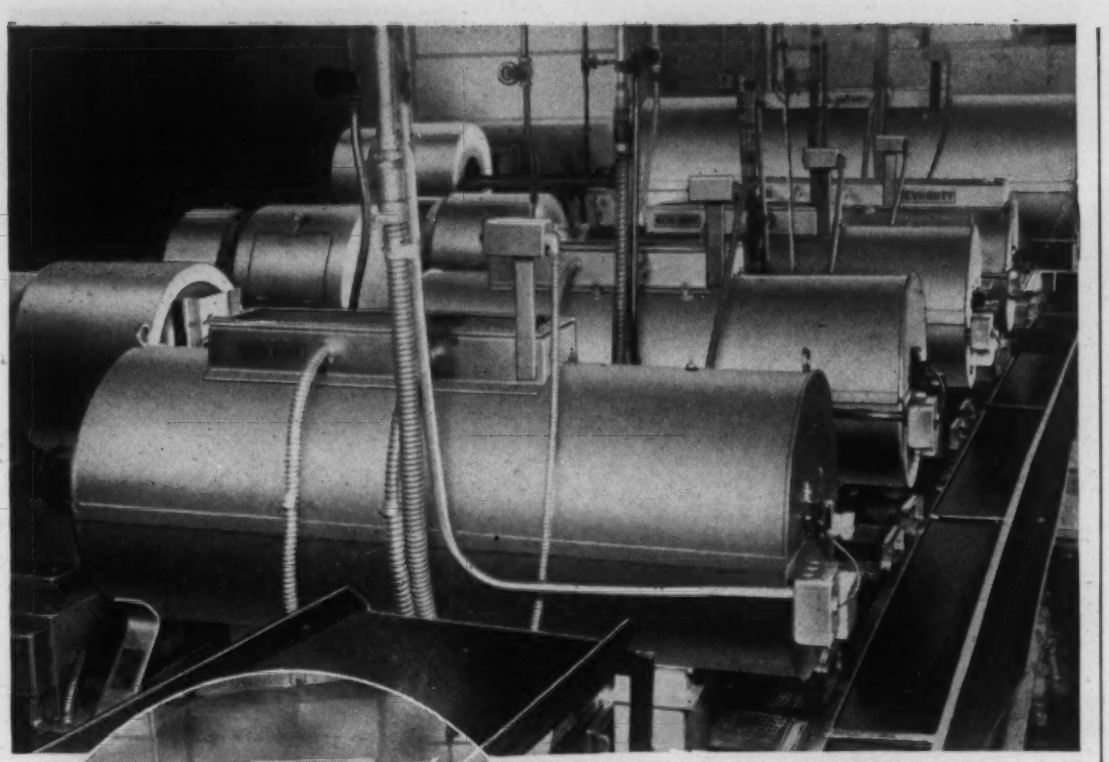
• A special tool removes any exterior weld flash from electric-welded steel tubing immediately after welding . . . thus the *eye-appeal* of products like tubular steel furniture. If required, the inside can be similarly finished, meeting the *functional* requirements of products like pneumatic tube systems.

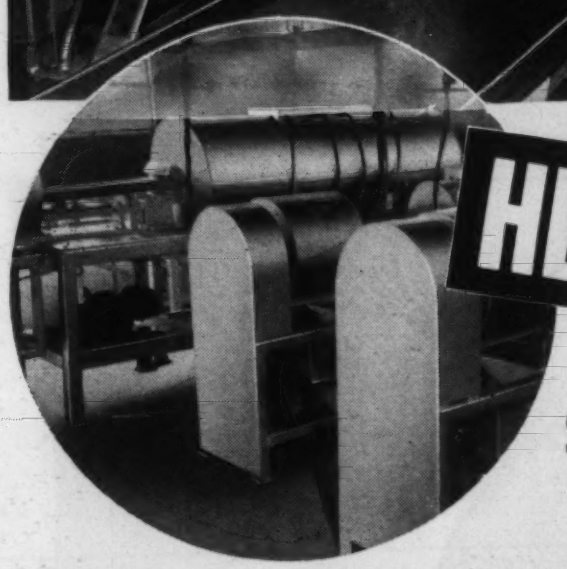
Investigate the economy and physical advantages of Brainard welded steel tubing for *your* products. Write Brainard Steel Division, Dept. X-5, Griswold Street, Warren, Ohio. An integrated producer; offices throughout the U. S.

Brainard
SHARONSTEEL
STEEL DIVISION
SHARON STEEL CORPORATION

WELDED STEEL TUBING

For more information, turn to Reader Service Card, Circle No. 385





HEVI DUTY

SHAKER HEARTH FURNACES

are saving MONEY...TIME...MATERIAL...

Oregon Saw Chain Corporation, the world's largest producer of top quality saw chain, uses five Hevi Duty Shaker Hearth Furnaces to harden saw teeth. They say, "We have solved a heat treating problem and have paid for the furnaces from the savings."

MONEY

The low cost, economical operation of the continuous production type Shaker Hearth Furnace has cut heat treating costs in half. Little maintenance means additional savings.

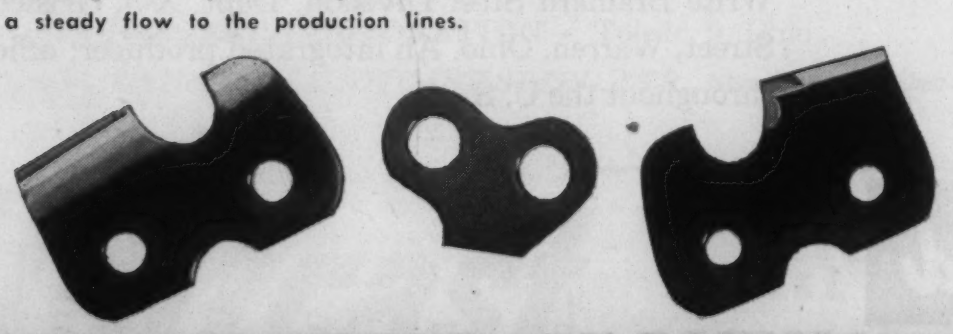
TIME

Now one man treats more than a ton of small parts every eight hours. Less handling of the parts is required with a steady flow to the production lines.

MATERIAL

The Hevi Duty Shaker Hearth Furnace treats each part individually. They pass through the furnace in a natural gas atmosphere and fall directly into the quench. This method hardens the saw teeth to 63-65 Rockwell with no rejects due to distortion and scale.

For more information about this modern production tool, write for Bulletin 850.



HEVI DUTY ELECTRIC COMPANY

MILWAUKEE 1, WISCONSIN

Heat Treating Furnaces...Electric Exclusively

Dry Type Transformers *Constant Current Regulators*

For more information, turn to Reader Service Card, Circle No. 384

New Materials, Parts and Finishes

applications in the automotive industry where they are used between wheel housings and trunk floor panels. Pressed into the gap by hand, the sealer cures and swells from 70 to 125%, filling all voids. The curing of the sealer takes place in the paint drying and baking ovens and does not require a separate heating cycle.

Normal packaging is in 30-in. lengths of 1/4-in. dia material, with each box containing about 810 linear feet of sealer. Other shapes and sizes are also available.

New Synthetic Rubber Compound For O-Ring Seals

A new synthetic rubber material has been developed for use in O-rings for sealing aviation type fuels under pressure conditions up to 1500 psi, over a temperature range of approximately —160 to —65 F.

Developed by *Goshen Rubber Co. Inc.*, Goshen, Ind., Compound 1120 is said to have low temperature flexibility and a pronounced tendency to recover rapidly from a shrunken condition to one of positive compression in non-aromatic fuel. It will not stick to metal, nor will it stain or pit metal.

New Tooling Resin Cuts Mixing Time

A new tooling resin with metal filler requires only five min mixing at 100 rpm to prepare it for use. The metal filler is suspended in the hardener and no hardener mixing is required prior to its being blended with the resin.

The new L-930 Surface Casting Resin, developed by *Rezolin, Inc.*, 5736 W. 96th St., Los Angeles 45, Calif., is said to have the advantages

an ACCO product

Wilson "ROCKWELL"* Hardness Testers

NOW...

you can own the BEST for only $550

(less accessories F.O.B. Bridgeport)

3-JR MODEL

6 Features for Tool Room and Production Testing

This MODEL 3-JR WILSON "ROCKWELL" Hardness Tester is proving invaluable for tool room use and most production testing. It will pay for itself many times over by eliminating costly complaints from your customers.

These features make for unusual accuracy and long life—

1 Totally enclosed dirt and dust-proof "Zerominder" dial gauge.

2 Gripsel clamp screw for quick change and proper seating of penetrator.

3 All controls conveniently grouped.

4 Enclosed, easy-to-reach, variable speed dash pot.

5 Stainless steel elevating screw.

6 Standardized weights.

This machine will test small work as well as the smallest size machine and requires but 12″ by 20″ of bench space. It has a maximum vertical capacity of 8″ and a horizontal reach of from 5¼″ to 5½″. The height from the bench to center line of the gauge is 24″.

Model 3-JR is furnished with 4 standard anvils. If heat-treated and hardened steel is being tested a diamond BRALE penetrator is necessary. This may be purchased at a small additional cost.

The many models of WILSON "ROCKWELL" testers for normal and superficial hardness testing offer the utmost precision for production as well as laboratory work. The various models of WILSON "ROCKWELL" and TUKON micro and macro hardness testers cover most of the entire range of scientific uses.

WILSON hardness testers are available in many styles with accessories for testing flats, rods, rounds and odd shapes. Let us tell you about WILSON TUKON for micro-indentation testing. Write today for literature and prices. **Trade Mark Registered*

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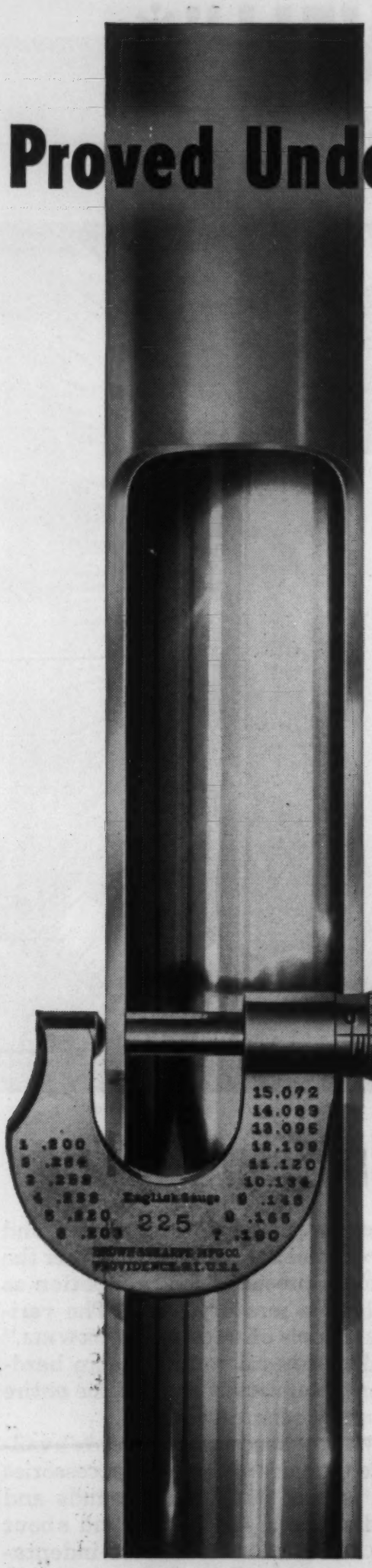


STANDARD CYLINDER TUBING

"Mirror Finished" to precision tolerances, it's used in automobile shock absorbers, power steering, hydraulic pumps . . . without further sizing or finishing.

Here's a busy part of an automobile shock absorber that's built for brutal punishment. It's Standard's modern "mirror-finish" Cylinder Tube. So that it won't weaken or leak under punishment, every inch of this tubular "toughie" must measure up to exacting specifications—in cylinder finish . . . in I.D. tolerances as close as .001" . . . in extreme uniformity of wall thickness and concentricity . . . in internal pressure resistance, to shocks up to 9000 P.S.I. The elimination of broaching or further processing of any kind effect significant savings for our customers in product assembly.

As you see here, the engineering involved behind the application of tubing to your product is *more than skin deep at Standard.* Our engineers will gladly show you why in helping you with your tubular application—whether it involves a simple structural or mechanical member . . . or a precision application.

Send for our 8-page folder or see Sweet's Design Catalog.

MAKE "STANDARD" YOUR SOURCE FOR—

- WELDED MECHANICAL TUBING
- WELDED STAINLESS TUBING
- BOILER AND HEAT EXCHANGER TUBING
- EXCLUSIVE "RIGIDIZED" PATTERNS

STEEL TUBING SIZES: ½" O. D. TO 5½" O. D. — .028 TO .260 WALL.
STAINLESS SIZES: ¼" O. D. TO 4½" O. D. — .020 TO .154 WALL.

For more information, turn to Reader Service Card, Circle No. 449

New Materials, Parts and Finishes

of metallic appearance, a very low viscosity when mixed, 2 to 4 hr hardening time at room temperature, non-corrosive qualities, and high metal bonding properties.

The material can be used for resurfacing metal dies, leveling die bases to eliminate machining, making form blocks, foundry patterns and core boxes. It is also said to be a good potting compound for precision locations and can be used for jig locator pads and hydro-press wedge blocks. As well as a surface casting resin, L-930 can be brush applied for glass cloth lamination for tough tooling applications.

Hot and Cold Units Treat Metals

Two new units have recently been developed for treating metals, one for sub-zero cold treatment and one for heat treating. The cold chamber can produce temperatures down to —170 F, while the heat treat furnace is said to offer high stability and accuracy.

Cold Unit

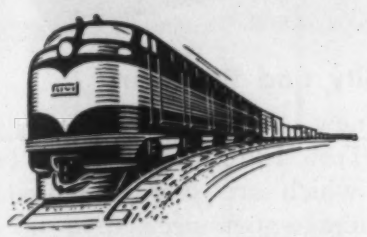
Low temperature Sub-Arctic chambers which will produce temperatures down to —170 F are being manufactured by *Tenney Engineering, Inc.*, 26 Avenue B, Newark 5, N. J. Typical metal-treating applications of the units are for quick-aging, stabilizing, stress equalization, shrink-fitting, hardening, and super-hardening of tool steels.

All the standard units have air or water-cooled condensing units using non-toxic, non-explosive Freon refrigerants. Chambers have aluminum liners and glass fiber insulation.

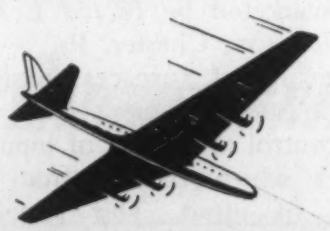
(Continued on page 242)

Why Alloy Steels?

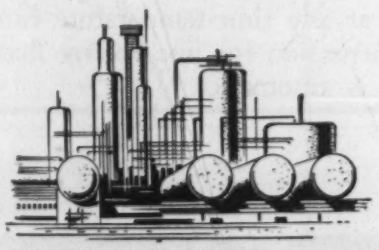
Carbon steels are better today than ever before. A major producer of both carbon and alloy steels, Republic is aware of this fact. Even so, there are limits to the application of carbon steels. Machine design may restrict the size of a part. High strength may be an essential combination with light weight. Sometimes surface hardness and ductility must be held within the limits. Such are the applications in which *only* alloy steels can perform definite tasks with certainty of results at lower ultimate cost.



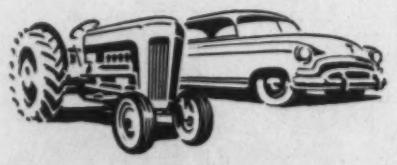
Take large sections—where hardness must be carried deep into the steel. Heavy crankshafts, connecting rods, piston rods, large gear and axles are examples. Here alloy steels *are necessary,* and the cost low in proportion to results. With carbon held constant, depth-hardening quality increases as the alloy content is increased.



Sometimes weight and space limitations demand that smaller sections carry heavier loads safely. For safety's sake, the answer *must be* alloy steels. Under repeated stress, high tensile strength and hardness do not necessarily indicate high fatigue properties. The load-carrying ability of a steel depends upon its alloy constituents and the form of the structure at the time it is bearing the load.



A problem of high pressures at elevated temperatures may present a problem. But alloy steels *have proved* their high resistance to creep. Some stainless alloys maintain high strength up to 1800° F. They resist oxidation—therefore do not lose their strength appreciably through reduction of section.



High elastic properties and strength may be the primary requirement, especially for welded structures. Weight reduction may be most important. In these applications, low carbon complex alloy steels *offer distinct advantages.* Such alloy steels at equal or higher yield points show low weld-hardening tendencies. Resistance to corrosion is improved. So is ductility of the weld. And retention of toughness at sub-zero temperatures, as well as creep resistance at high temperatures, is better.

To help you get the most from alloy steels, Republic offers you its unique 3-D Metallurgical Service. You benefit from the combined experience and coordinated efforts of three groups of highly-trained men—(1) the Republic Field Metallurgists; (2) the Republic Laboratory Metallurgists; (3) the Republic Mill Metallurgists. All work hand-in-hand to help you do the job you want done with alloy steels at the lowest possible cost. Ask us about this service.

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REPUBLIC ALLOY STEELS

Other Republic Products include Carbon and Stainless Steels—Sheets, Strip, Bars, Wire, Pig Iron, Steel and Plastic Pipe, Bolts and Nuts, Tubing

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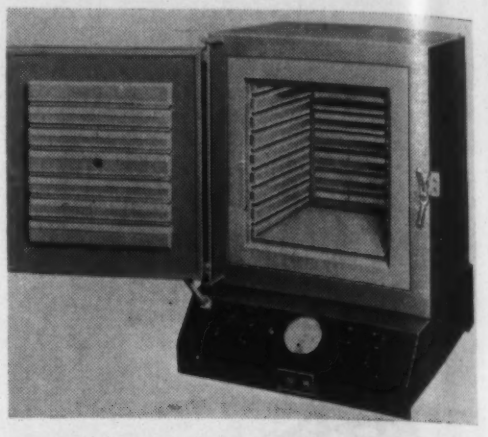
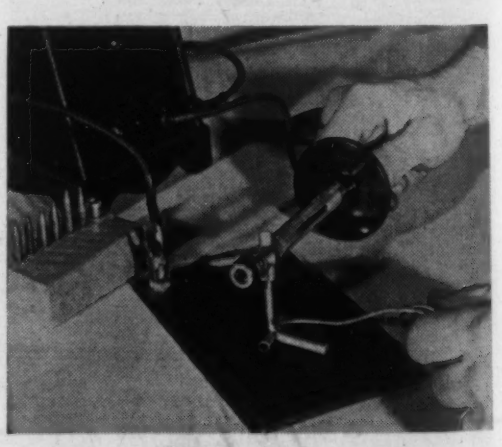


Stability and Precision

A new line of furnaces called Dyna-Trol Industrial Electric Furnaces which are said to reproduce any time-temperature curve up to around 2000 F within ±3 F, has been marketed by *L and L Manufacturing Co.*, Chester, Pa.

The line of furnaces consists of over 40 standard models and offers zone control my means of input controllers which control from 8 to 100% of input. This allows for equalization of vertical zone temperatures at any time-temperature curve. Compensation for line voltage fluctuation is automatic.



Spot Solderer Speeds Joining

A new soldering tool which has changeable carbon tips, and heats upon contact with the work has been developed by *Newage International Inc.*, 235 E 42nd St., New York 17.

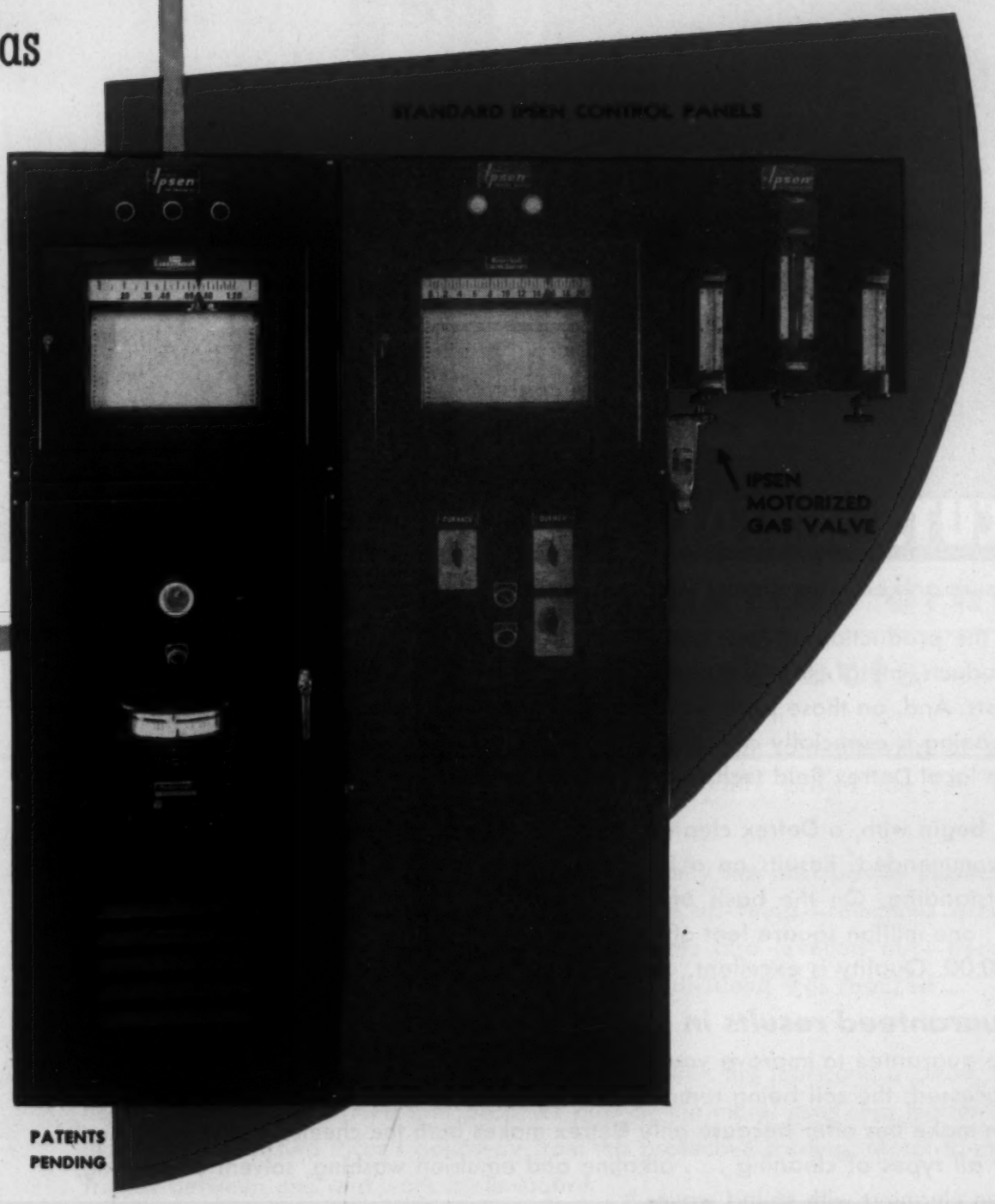
The tool operates on low voltage supplied through an a.c. single phase transformer which heats the tool upon contact of the tip with the work. The heat then shuts off automatically when contact between the tool and the work is broken.

The two angled carbon tips are optional and can be replaced by a

NOW...

You No Longer Need to Worry About the Amount Of Carburizing Gas to Add

Ipsen CARBOTRONIK



✓ Automatically controls furnace atmosphere carbon potential.

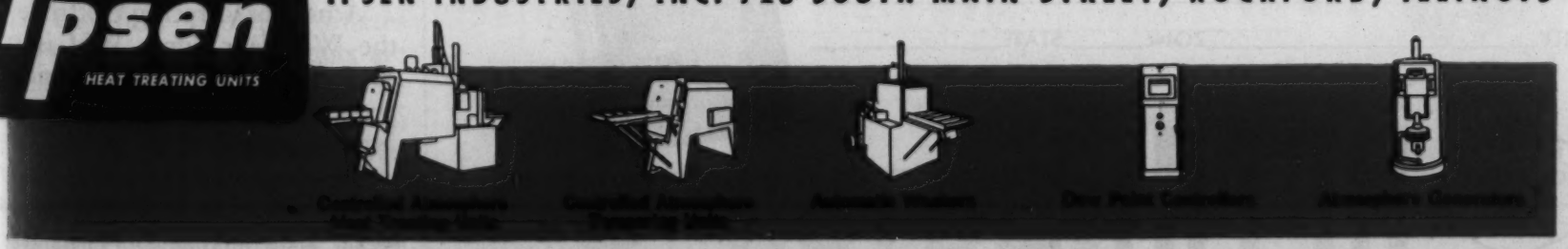
✓ Eliminates constant supervision and guesswork.

✓ Simply set the controls to desired carbon potential...and forget it.

AUTOMATIC **Ipsen** HEAT TREATING UNITS

Universal Production Units in Standard Sizes 100 to 2000 LB./HR.

IPSEN INDUSTRIES, INC. 720 SOUTH MAIN STREET, ROCKFORD, ILLINOIS



For more information, turn to Reader Service Card, Circle No. 334

ANOTHER CASE OF DETREX Service WITH A Saving AT WORK

CUTS METAL CLEANING COSTS 2/3

A sure and easy way to cut your cleaning costs is to follow the lead of Servel, Inc. —

In the production of their automatic ice maker refrigerators and air conditioning products, metal cleaning plays an important role in relation to both quality *and* costs. And, on those parts which are porcelain enameled, the importance of metal cleaning is especially critical. Here are the savings that resulted when Servel and the local Detrex field technician worked together on the subject.

To begin with, a Detrex cleaner specially developed for porcelain enamelers was recommended. Results on a lab basis looked good . . . production results were outstanding. On the basis of accurately compiled data, costs have dropped ⅔ . . . one million square feet of metal is cleaned at a total cleaner cost of less than $60.00. Quality is excellent.

Guaranteed results in your plant, too . . .

We guarantee to improve your cleaning operations, regardless of the parts being processed, the soil being removed, or the type of cleaning required! Only Detrex can make this offer because only Detrex makes *both* the chemicals and equipment for *all* types of cleaning . . . alkaline and emulsion washing, solvent degreasing, even cleaning with sound waves.*

You can get all the facts by filling out the coupon below. Do it now for lower costs.

**Detrex Soniclean Process®*

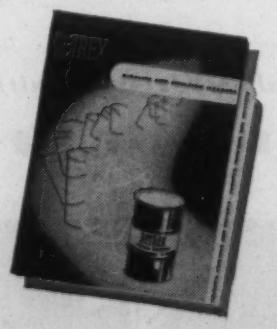
Please send me the Detrex Cleaner file. We'd also like data on how we can cut our metal cleaning costs and improve quality.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____



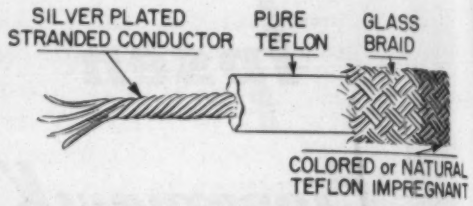
DETREX CORPORATION

DEPT. HD-102, BOX 501, DETROIT 32, MICH.

New Materials, Parts and Finishes

normal tip. The double tip is said to add versatility to the work which can be done economically with the tool. The carbon tips can be machined to any shape to facilitate work on unusual parts.

A synthetic insulating handle at the end of the tool is formed to act as a shield against the heat of the tip, and the transformer offers a selection of 6 different heat intensities. The carbons are supplied in 3/16, ¼ and 5/16-in. dia sizes.



Teflon and Glass Insulate Lead Wire

Lead wire for electronic and electrical components is being produced with Teflon as the primary conductor insulation, and Teflon-impregnated glass braid as the secondary insulation.

Developed by *Hitemp Wires, Inc.*, 26 Windsor Ave., Mineola, L. I., Tempclad is said to withstand operating temperatures ranging from —60 to 392 F, and to possess the insulation advantages of the fluorocarbon plastic. These are: high dielectric strength, low power factor, high insulation resistance, low dielectric constant. In addition it is inert to most commercial solvents.

Tempclad wire is said to be suitable for use with equipment working at a.c. potentials to 600 v rms in aircraft and other critical applications. It is a stranded construction, manufactured in sizes 28 AWG to 10 AWG inclusive, in 8 solid colors. Tracer colors are also available.

High Strength Hard Facing of Manganese Steel

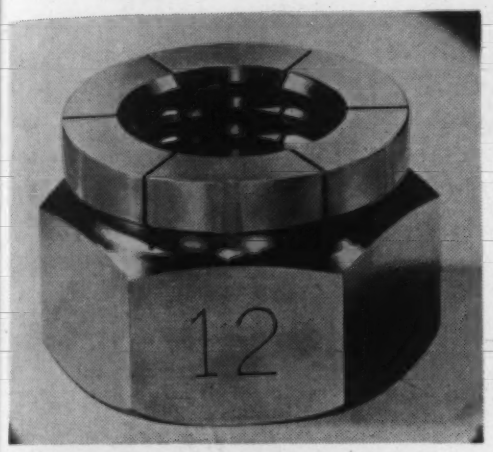
A new hard facing electrode called the Wear-Arc Super WH is said to provide high strength and wear properties in welding and hard facing manganese steel.

Developed by the *Alloy Rods Co.*, York, Pa., the new electrodes use

For more information, Circle No. 540

New Materials, Parts and Finishes

core wire containing approximately 33% alloy. Having a carbon content of 0.35%, the electrode is said to produce hardness equivalent to alloy steels containing three times this carbon content. This low carbon content is said to prevent spalling and flaking of the weld deposit under operating conditions producing severe impact.



Locknuts for 1200 F Service

Stainless steel locknuts, silver plated to eliminate galling and seizure of threads, are now available for high temperature applications up to 1200 F.

Developed by *Standard Pressed Steel Co.*, Jenkintown, Pa., the Flexloc SPS series 99F12 nuts are machined from AMS-5642 stainless steel and are said to conform to MIL-N-7873 spec.

The one-piece nuts lock in place at any point along the bolt or stud, the locking action being provided by six slotted segments in the top of the nut. These segments are closed in to make the i. d. of the locking collar smaller than the o.d. of the companion bolt. As the nut is applied, the bolt pushes back the resilient segments and the resulting spring tension holds the nut securely in place. The nuts can be re-used without reducing their locking capacity.

Designed for gas turbine tail cones, exhaust manifold systems, furnaces and firewall assemblies, the nuts are made in 7 standard sizes with dia ranging from No. 10 through 9/16 in. Threads are National Fine series.

(Continued on page 246)

For more information, Circle No. 547 ➤

ANOTHER CASE OF DETREX Service WITH A Saving AT WORK

DETREX EXTRUDITE

gives a smoother, better draw . . . with fewer rejects

One of the toughest tests for any metal lubricant is the cold drawing of steel tubing. At Summerill Tubing Company, Detrex Extrudite passes this test with flying colors.

Summerill's production standards are so high that only the best passes inspection. With Extrudite, Summerill found production on the up-swing—rejections greatly lowered. Quality control of tube I.D.'s and surfaces also levelled out—became easier to maintain. With Detrex Extrudite, another dividend was realized . . . rust on tube I.D.'s is virtually eliminated.

Extrudite's secret is simple. When metal is coated with this lubricant, a clean, dry, heat-resistant film is formed that becomes part of the metal itself. No matter how the metal is stretched it can't get away from this protective coating. Metal-to-metal friction between dies and work is eliminated.

You, too, can benefit through this revolutionary improvement in lubricants. With Detrex Extrudite on the job, all types of drawing, cold heading and extruding become simpler and more economical. Remember . . . like all Detrex products, the Extrudite Process is fully guaranteed. Write for our descriptive booklet today.

Please send us your free descriptive bulletin on the Extrudite Process.

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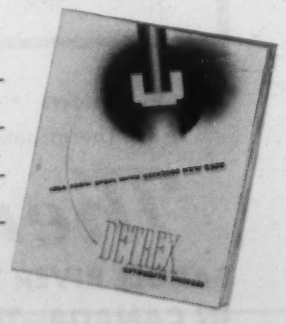
COMPANY_____

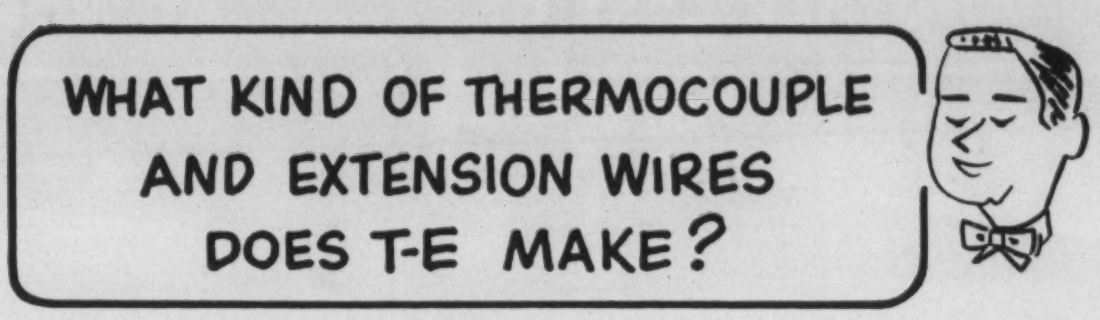
ADDRESS_____

CITY_____ ZONE_____ STATE_____



DETREX CORPORATION

DEPT. PC-102, BOX 501, DETROIT 32, MICH.



Thermo Electric makes thermocouple and extension wires to "MIL" specifications and industrial standards. Each step in their production, from wire drawing and insulating to final testing, is handled carefully in T-E's own plant. Furthermore, T-E's engineers will develop special wires or cables you may need for unusual pyrometric applications. Most standard wires, including MIL-W-5845, 5846, and 5908, in all types and classes, are shipped from stock, specials are produced promptly.

THREE, STANDARD, T-E INSULATIONS

NN—nylon insulated conductors, nylon overall—provides excellent protection against abrasion.

TG—teflon insulated conductors, hi-temp varnish-saturated fiberglass overall—protects wires from moisture and petroleum products at temperatures up to 600°F.

HGHG—hi-temp fiberglass insulated conductors, hi-temp fiberglass overall—suitable for temperatures up to 2000°F.

* There are too many T-E wires to mention comfortably in one ad. However, in T-E's Wire Bulletin, you can see four pages of insulated wires, their gages, and calibrations. And, there's more: a page of charts shows calibration symbols, color codes, and insulation characteristics. Two additional pages contain engineering data: resistances of solid and stranded conductors, weights, electrical properties, and conduit capacities. Write for your copy—ask for Bulletin 31-G.

Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

Thermo Electric Co., Inc.

SADDLE RIVER TOWNSHIP, ROCHELLE PARK POST OFFICE, NEW JERSEY
IN CANADA—THERMO ELECTRIC (Canada) Ltd., BRAMPTON, ONTARIO

For more information, turn to Reader Service Card, Circle No. 380

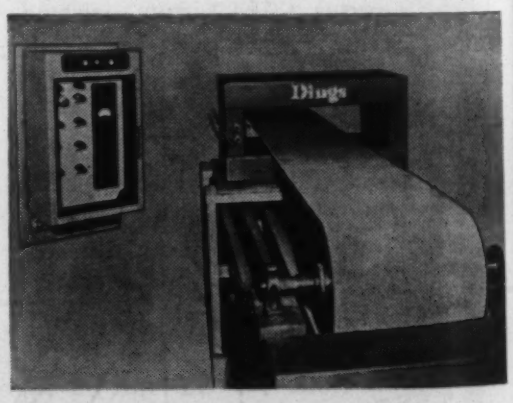
New Materials, Parts and Finishes

Seam Sealing Tape Has Low-Temperature Flexibility

A new sealer which will resist water, oil, gasoline and aromatic fuels and will not become brittle or lose adhesion at —70 F has been developed by *Presstite Engineering Co.*, 3798 Chouteau Ave., St. Louis 10, Mo. Known as No. 590.5, the Seam Sealing Tape is extruded in tape form down to 0.020 in. thick and in beads down to 1/8 in. dia.

The non-volatile sealer can also be furnished in bulk form, and is a combination of plasticized thiokol and asbestos fiber. According to the company it is unaffected by temperatures up to 175 F and will adhere to metals, glass, wood and plastics.

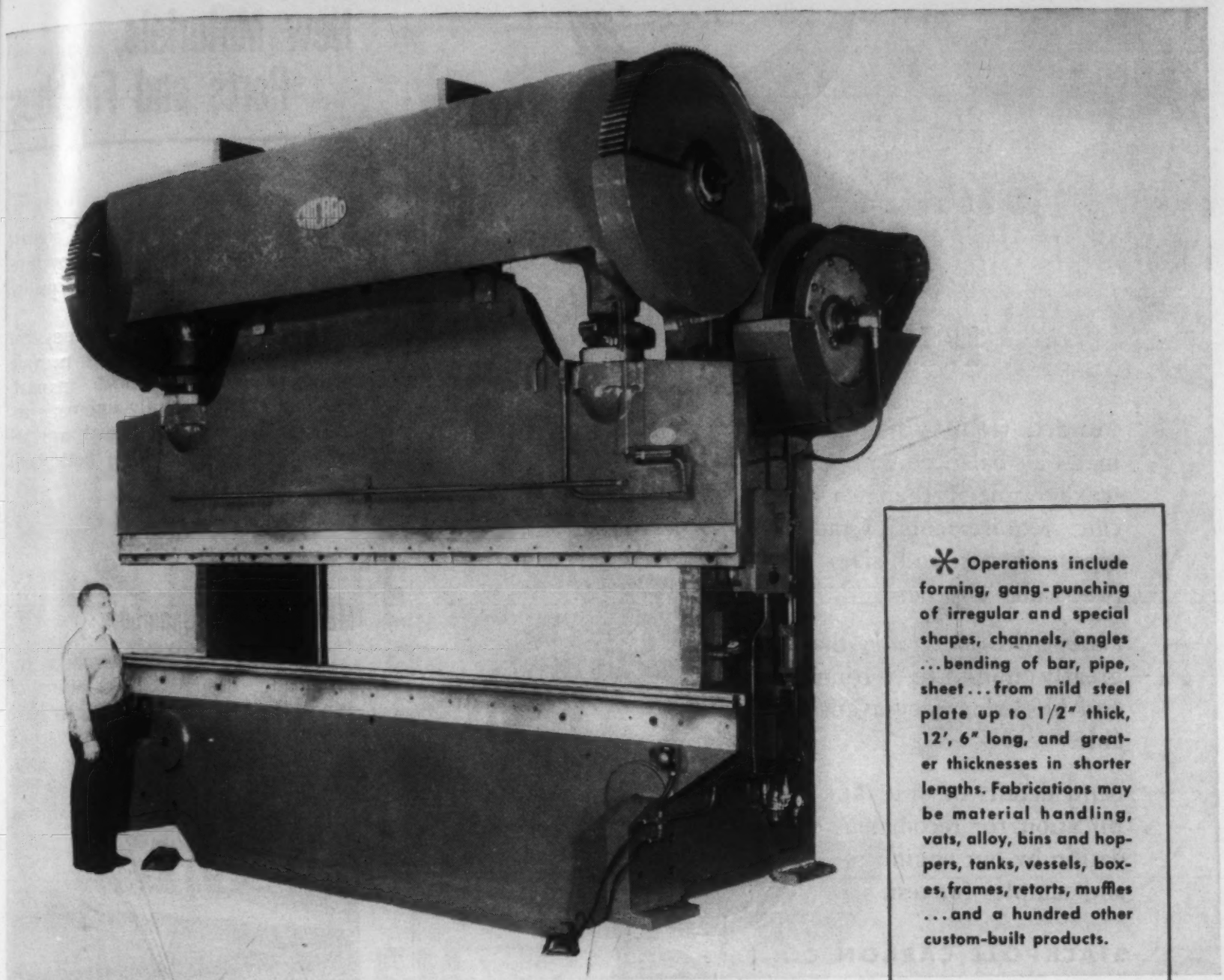
It is said to be suitable for use in the aircraft industry for sealing glass closures, bulkheads and fuselage openings, particularly in high altitude pressurized planes. Other applications include sealing riveted seams in aluminum boats, mobile homes and other types of aluminum fabrications.



Electronic Detector Spots Tramp Metal

A new Electronic Metal Detector which will detect ferrous or non-ferrous tramp metal carried on a conveyor belt has been developed by *Dings Electronics, Inc.*, 4740 W. Electric Ave., Milwaukee 46, Wis.

The detector is available in two basic types, for general industrial service or for deep burden service such as mining. It is said to detect



✻ Operations include forming, gang-punching of irregular and special shapes, channels, angles ...bending of bar, pipe, sheet... from mild steel plate up to 1/2" thick, 12', 6" long, and greater thicknesses in shorter lengths. Fabrications may be material handling, vats, alloy, bins and hoppers, tanks, vessels, boxes, frames, retorts, muffles ...and a hundred other custom-built products.

I AM A NEW MACHINE ALL SET TO PRODUCE FOR YOU

The name, gentlemen, is Chicago Press Brake, and I have just been installed in the plant of Rolock Incorporated, Fairfield, Connecticut. They have asked me to speak for myself.

First of all, you can see that I'm a husky specimen . . . 17 feet in height, 80,000 lbs. in weight . . . with a tremendous capacity for producing heavy work. I have joined the Rolock machinery group partly to lower costs and speed production of our fabricated heat and corrosion resistant alloys . . . and also to handle larger and stronger components for the chemical and food processing fields.

I shall be working with highly experienced engineers, fabricators and welders, who have made Rolock a top name for supplying engineered-to-the-job Heat Treating equipment for the country's leading metal working plants.

So, as the most versatile tool in any fabricating plant, Rolock is offering my products for the solution of your problems concerned with fabrication ✻ you may require. Mr. Roger P. Welles, President of Rolock Incorporated, has suggested that you write to him, personally, for discussion of your needs . . . and, if desired, our engineering recommendations.

ROLOCK INCORPORATED
1282 Kings Highway
Fairfield, Connecticut

BRLB4A

For more information, turn to Reader Service Card, Circle No. 455

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Seal
RINGS

Molded from carbon-graphite materials balanced with resins, waxes or metals to match specific requirements. Grades, types, shapes and sizes for practically any need.

New Oil Seal Grades that greatly minimize pitting and blistering now available.

Send details of your application for recommendation by our engineers and samples for test.

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STACKPOLE

"everything in Carbon but diamonds"

BRUSHES FOR ALL ROTATING ELECTRICAL EQUIPMENT
ELECTRICAL CONTACTS
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TROLLEY and PANTAGRAPH SHOES
CARBON PILES
FRICTION SEGMENTS
RESISTANCE WELDING and BRAZING TIPS

...and many other carbon, graphite and molded powder products

For more information, turn to Reader Service Card, Circle No. 360

New Materials, Parts and Finishes

even minute particles of metal, signalling their presence and thereby protecting machinery and product quality against tramp metal damage.

A range of signal and reject system arrangements is available to provide automatic detection, with manual, semi-automatic or fully-automatic rejection of metal. Included are arrangements for handling both bulk and packaged materials.

Materials Test Chambers

A variety of test chambers for producing desired temperature or atmospheric conditions or both have recently been developed by various manufacturers. Some are new, some redesigned or improved, but each is particularly applicable for certain test purposes and conditions.

Temperature Range Extended For Portable Unit

The TC2 Temperature Test Chamber, manufactured by the *Statham Development Corp.* 12411 W. Olympic Blvd., Los Angeles 64, has an increased range as compared with the old model, widening the operating limits to —65 and 350 F.

A Weston industrial thermometer is permanently mounted on the front panel and a loading port at the top of the chamber permits the addition of dry ice during extended operation at low temperature.

The unit is portable, designed for the individual research worker or the small production unit. The chamber is suited for ambient temperature variation tests of small products such as electronic sub-assemblies, components, paints, foods, dyes, textiles, organic materials, plastics, rubber and hydraulic or pneumatic accessories.

(Continued on page 250)

It's Practically

WATER-WHITE

a NEW

chemically resistant

baking finish–

DURACHEM

For all types of metal products from heavy hardware to fine jewelry

Here is a new baking type synthetic finish for metal parts that combines unusual clarity with a high degree of chemical resistance.

Product of Maas & Waldstein Co. research, DURACHEM is almost water-white in color—and retains its clarity even after prolonged exposure to heat and sunlight. It also protects metal parts against the effects of salt spray and perspiration.

Typical applications include builders' hardware, vanity and cosmetic cases, lipstick shells and pen caps.

Where decorative color effects are desired on metal, DURACHEM can be supplied in a range of colors with the same chemical stability as the clear finish.

OUR 78th YEAR

PIONEERS M&W.Co 1876 IN PROTECTION

Samples and technical literature are available on request. Or an M & W technical consultant will discuss your requirements privately with you.

MAAS & WALDSTEIN CO.

2112 McCarter Highway • Newark 4, New Jersey

MANUFACTURERS OF INDUSTRIAL FINISHES

Midwest Division:
1658 Carroll Avenue, Chicago 12, Ill.
Pacific Coast Div., Smith-Davis Co.
10751 Venice Blvd., Los Angeles 34, Calif.

For more information, turn to Reader Service Card, Circle No. 443

It *was* a problem making threads hold in softer, lighter materials... producing threads that would *never* wear, seize, corrode or gall.

But not since ***Heli-Coil**** Screw Thread Inserts! They make weak threads strong and *perfect*. And they save you weight, space and money because you can use fewer, smaller, shorter fastenings, smaller bosses and flanges.

When it comes to threaded fastenings, thousands of manufacturers throughout the world use ***Heli-Coil*** Screw Thread Inserts to answer their design, manufacture and field service problems. Send today for full information, specifications and samples. And a ***Heli-Coil*** Thread Engineer will be happy to assist at your request.

***Heli-Coil* Inserts conform to official Military Standards MS-122076 (ASG) through MS-124850 (ASG) and others.**

*Reg. U. S. Pat. Off.

HELI-COIL CORPORATION
185 SHELTER ROCK LANE, DANBURY, CONN.

☐ Please send samples and Bulletin 689—Military Standards Sheets.
☐ Please have a *Heli-Coil* Thread Engineer call.
☐ Send samples and Handbook 652, a complete design manual.

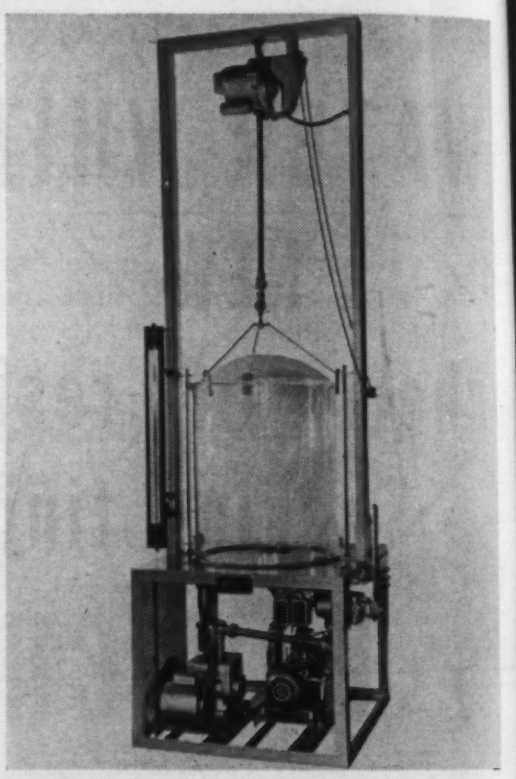
NAME_____ TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____ 2711

For more information, turn to Reader Service Card, Circle No. 319

New Materials, Parts and Finishes

The working space is 7 in. high, 15 in. wide and 7½ in. deep. The test load is carried in a removable tray provided with 15 openings, ⅜-in. dia, for connections to the objects under test.

The circulating air is cooled by dry ice, and heated by a thermostatically controlled electrical resistance heater.



Unrestricted View of Test

A vacuum chamber which allows unrestricted viewing of the entire piece under test at all times has been developed by the *American Research Corp.*, Bristol, Conn.

Within the glass jar, enclosing a working space 24 in. high and 24 in. in dia simulated atmospheres up to 100,000 ft are possible, while up to 60,000 ft conditions encountered in a rate of climb of 32,000 ft per min can be reproduced.

Standard equipment for the unit includes safety devices, manometer, electrical terminals, and access penetrations in the base plate.

Hot-Cold Automatic Cycling

A testing chamber which automatically cycles test parts through alternating hot and cold temperatures has been developed by the *Cincinnati Sub-Zero Products Co.*, 3932 Reading Rd., Cincinnati 29.

The Sub-Zero Test Unit ST-120-3, which has a test chamber 30 in. long,

Heat in a Hurry-at Low Cost!

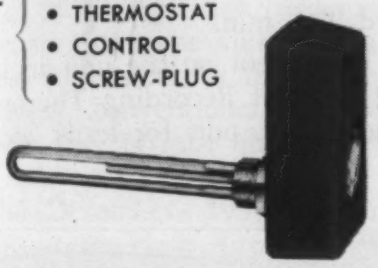
CHROMALOX

Pre-engineered **PACKAGED** Electric Heaters

COMPLETE HEATING UNITS READY FOR YOUR JOBS—FROM THE WORLD'S LARGEST STOCK OF STANDARD EQUIPMENT

ARTM Automatic Immersion Heaters

BUILT IN
- ELEMENTS
- THERMOSTAT
- CONTROL
- SCREW-PLUG

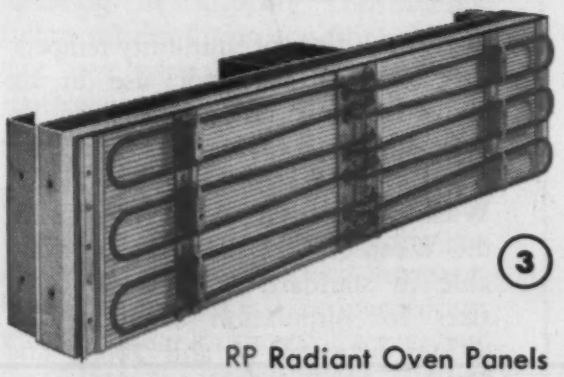


1

NWH Automatic Circulation Heaters

BUILT IN
- ELEMENTS
- THERMOSTAT
- HEATING CHAMBER
- INSULATION
- MOUNTING LUGS

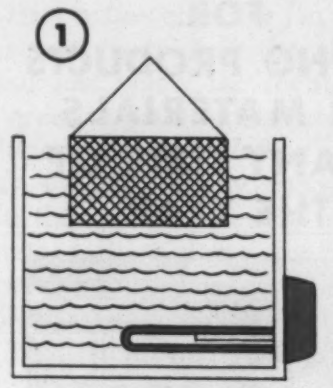
2



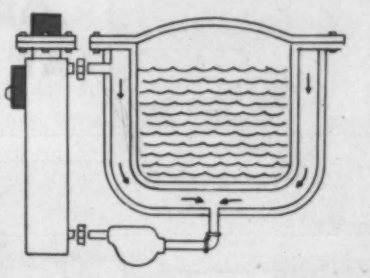
3

RP Radiant Oven Panels

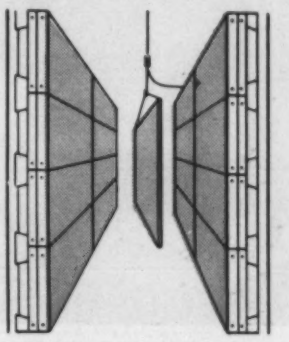
BUILT IN
- STEEL FRAME
- METAL SHEATHED ELEMENTS
- REFLECTORS
- PREHEATING AIRWAYS
- INSULATION
- BUS BARS



1 **IMMERSION HEATERS**
Screw-in immersion heater used in typical liquid heating application. Thermostat controls temperatures.



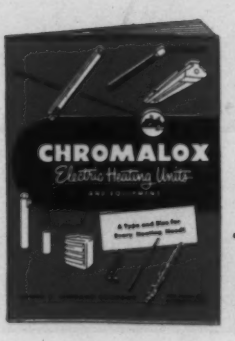
2 **CIRCULATION HEATERS**
Typical application of circulation heater connected to process kettle. For temperatures up to 700°F.



3 **RADIANT OVEN PANELS**
Banks or ovens in days with ready-to-erect and connect panels. Controls to provide zones of heat.

CHROMALOX PACKAGED ELECTRIC HEATERS are ready to go to work on the heating jobs in your plant. Easy to install, they may be used as permanent or portable heat sources to give you clean, dependable, accurately controlled heat at temperatures required. Heaters are available for degreasing, cleaning, pickling and plating; for melting greases, asphalts and similar viscous fluids; for heating air and other gases; and for preheating fuel oils and superheating steam.

Nationwide application assistance, plus immediate delivery from the world's largest stock of electric heating equipment.



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7523 Thomas Boulevard, Pittsburgh 8, Pa.

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☐ Have a Chromalox Application Engineer get in touch with me.

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Electric Heat for Modern Industry

DESIGNERS AND MANUFACTURERS OF ELECTRIC HEATING UNITS EXCLUSIVELY SINCE 1917

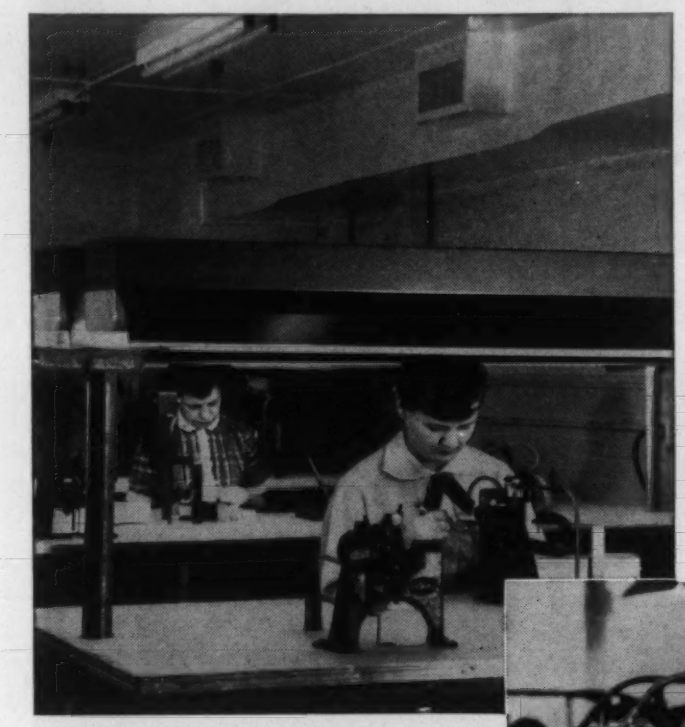
For more information, turn to Reader Service Card, Circle No. 344

A NEW more reliable air conditioning method

with exact moisture control

FOR YOUR PROCESS OR PROTECTION

FOR TESTING PRODUCTS OR MATERIALS AT ANY TIME OF THE YEAR



ASSEMBLING ELECTRONIC PARTS

PACKAGING FOOD PRODUCTS

● This Niagara "Controlled Humidity" method gives you the **MOST EFFECTIVE** Air Conditioning because its cooling and heating functions are made completely separate from adding or taking away moisture. This assures you always a precise result. No moisture sensitive instruments are needed.

MOST FLEXIBLE. You can reach and hold any condition in response to instrument settings, or vary it as you wish.

EASIEST TO TAKE CARE OF. The machine is accessible, the control circuits are simple and easy to operate, and there are no solids, salts or solutions to be handled.

MOST COMPACT. It does a very large amount of work in a small space.

INEXPENSIVE TO OPERATE. At normal atmospheric temperatures (unlike systems that use refrigeration to dehumidify) it needs no summer re-heat.

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NIAGARA BLOWER COMPANY

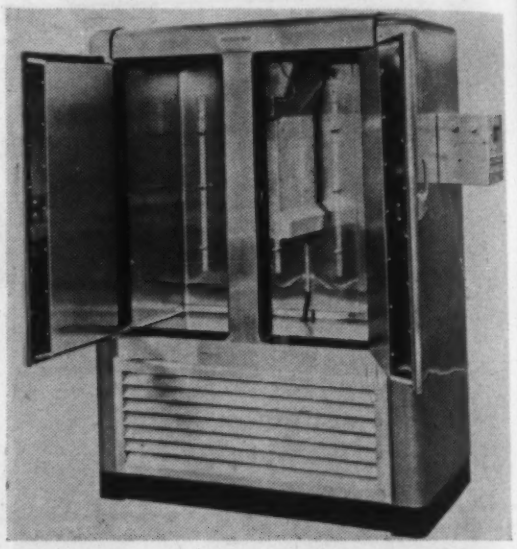
DEPT. MM, 405 LEXINGTON AVE. NEW YORK 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

New Materials, Parts and Finishes

11 in. wide and 16 in. deep, first produces a low temperature down to —120F; it then raises the temperature up to 200 F max, and can repeat the cycle up to 100 times. Holding times at high and low levels are variable with a dual-set timer which can be set anywhere between 0 and 120 min.

Equipment on the unit includes a 24 hr chart Recording Thermometer and a 2 in. port for leads, etc.



Above Freezing

A new line of humidity-temperature test cabinets for use in the above-freezing range has been developed by *Hudson Bay Div., Refrigeration Systems, Inc.*, 646 W. Washington Blvd., Chicago 6. Called the Weather-Lab, the units are available in standard 20 and 30 cu ft sizes for simulation of most conditions between 35 and 200 F and between 20 and 95% humidity.

The units are suitable for testing products for conformance to above-freezing JAN, MIL, and other government environmental specs.

The basic unit is equipped with an exterior-mounted control panel with adjustable wet and dry bulb thermostats. Also included are individual switches and pilot lights controlling and indicating the operation of various elements of the system. Optional cam-operated program controllers provide programming of the wet and dry bulb functions on a predetermined time cycle.

For more information, turn to Reader Service Card, Circle No. 310

Contents Noted

A digest of papers, articles, reports and books of current interest to those in the materials field.

This Month:

- *Aluminum Heat Treating*
- *New Alloys May Save Nickel*
- *Decorating Plastics—Which Method?*
- *How To Form Gas Turbine Blades*

Some Basics in Heat Treating Aluminum Casting Alloys

Due to the precipitation hardening characteristics of some aluminum alloys, heat treatments for these alloys differ from conventional methods used for the ferrous metals and alloys.

In the December, 1953 issue of *Metal Treating,* H. J. Rowe and W. E. Sicha of Alcoa discuss some of the fundamentals of heat treating aluminum casting alloys. The types of heat treatment covered are:

—T2—Annealed
—T4—Solution heat treated
—T5—Artificially aged only
—T6—Solution heat treated and then artificially aged
—T7—Solution heat treated and then stabilized

Annealing

This type of treatment has limited commercial application, according to the authors. Annealing of aluminum casting alloys is done to relieve internal stresses, or to bring about precipitation of alloying constituents from a solid solution condition which may have been brought about by a relatively rapid rate of cooling in production.

Although the annealed castings have a structure that is practically insensitive to change at normally encountered elevated service temperatures, the mechanical properties are usually similar to those of the as-cast material. In some alloys tensile strengths will be slightly lower after annealing, and elongations slightly higher than in the as-cast condition.

Solution Treatment

Casting alloys susceptible to solution heat treatment are those in which the solid solubility of the alloying element increases with increase in temperature. Aluminum - copper and aluminum-magnesium alloys have this characteristic and form the basis for commercially important casting alloys.

The main objective in solution treatment is to heat the alloy to a point just below the melting range in order to get a supersaturated solid solution of the alloying elements, then to chill rapidly enough to retain the solid solution at room temperature. By so doing, conditions are established for successive precipitation hardening.

The maximum permissible temperature for gaining the solid solution condition is governed not only by the eutectic, but by the strength of the alloy at the elevated temperature, since castings should be capable of retaining their shapes with little or no support during the solution treatment. And in regard to time of treatment, permanent mold castings can be treated in a shorter time than sand castings, since solution is more rapid in castings with a small macro grain size and fine dendritic structure.

Precipitation Hardening

The authors point out that a supersaturated structure such as is produced by solution treatment tends to adjust to equilibrium conditions. The alloy constituent or compound is precipitated from solid solution in the course of this adjustment. This precipitation can be restrained by a low enough temperature, or it can be ac-

Some Generally Used Commercial Heat Treatments*

Alloy and Final Temper	Solution Heat Treatment[1]		Artificial Aging Heat Treatment	
	Temp—F[2]	Time—Hr[3]	Temp—F[2]	Time—Hr[3]
122-T61	950	12	310	10–14
142-T21	—	—	650	2–4
142-T571	—	—	340	22–26
142-T77[1]	960	6	650	1–3
195-T4	960	12	—	—
195-T6	960	12	310	3–6
195-T62	960	12	310	12–20
319-T6	940	12	310	2–5
355-T51	—	—	440	7–9
355-T6	980	12	310	3–5
355-T7	980	12	440	3–5
355-T71	980	12	475	4–6
356-T51	—	—	440	7–9
356-T6	1000	12	310	3–5
356-T7	1000	12	400	3–5
356-T71	1000	12	475	2–4

NOTES:

[1] The solution heat treatment is followed by quenching in water at 150 to 212 F except for 142-T77 sand castings, which are quenched in still air. A boiling water quench is recommended, since it minimizes quenching stresses and distortion.

[2] Nominal metal temperature should be maintained with as little variation as possible during the recommended time at temperature. Furnaces capable of maintaining the temperature well within plus or minus 10 F of that desired are readily available.

[3] The exact time required is influenced by foundry variables and may have to be adjusted, from experience to secure the typical properties for the alloy and temper.

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means top quality
...Swepco quality

Call for ASTM Specification A358-52T and rest assured you're getting the best obtainable in welded austenitic heavy walled pipe.

Higher stress values

This specification demands qualified operators and rigorously exact procedures. It covers every aspect of manufacture and insures complete quality control. An important advantage is that pipe has higher stress values in design.

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It will pay you to look into this "spec"—a free copy is yours for the asking from SWEPCO, which has long been meeting the high standards set by this and other codes.

Swepco pipe, tubing and welding fittings, 3" to 48" O.D., are obtainable in stainless steel, nickel alloys, titanium, Carpenter "20", Hastelloy alloy, other alloys. Lengths up to 20 feet; extra heavy schedules and with high cylinder finishes.

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For more Information, Circle No. 369

celerated by elevated temperatures.

The structural changes brought about by precipitation alter the mechanical and some of the physical properties of the alloy. There is usually a relatively rapid increase in hardness to a "peak" followed by a decrease at a moderate rate, and then further decrease at a progressively reducing rate for an extended period of time. In general, the tensile and yield strengths vary directly and the elongation inversely with hardness.

Artificial Age Hardening

Artificial aging is a production term used for any heat treatment whose purpose is to increase the speed of precipitation of the alloy constituent or compound. These treatments are necessary in some cases because precipitation at room temperature is so slow.

Artificial aging only, when applied to castings in the as-cast condition, is effective because most castings cool rapidly enough in production to retain a considerable degree of supersaturation of solid solution at room temperature. Treatments of this type, according to the authors, increase the tensile and yield strengths and the hardness, with some sacrifice of elongation.

A second type of artificial aging is the low temperature treatment used after a solution heat treatment. In some cases the aging portion of these treatments is designed to produce maximum hardness with the attendant higher tensile and yield strengths and lower elongation. Other aging treatments effect a compromise, providing somewhat lower tensile and yield strengths and hardness to retain higher elongations.

A third type of artificial aging treatment described by the authors is an intermediate temperature treatment following a solution treatment. The higher temperatures produce a stabilized material. Such treatments are used to gain substantial freedom from growth in castings that are to be operated at elevated temperatures and removal of internal stresses.

New Alloys Promise Nickel Economies

The substitution of manganese for nickel in ferrous and nonferrous alloys is being explored by many producers. In the field of white alloys, largely covered by the nickel-silvers at present, there is a demand for alternate alloys having good mechanical properties and corrosion resistance.

In a paper printed in *The Journal of The Institute Metals* (British) in September last year, J. C. Blade,

Mechanical Properties of Sheet

Composition %, Balance Copper	Heat Treatment	Tensile Str, Psi	Elong % in 2 in.
16 manganese, 8 tin	(1)	57,500	48
	(2)	76,000	4
	(3)	103,000	2
	(4)	123,000	1.5
20 manganese, 8 tin	(1)	71,000	47
	(5)	59,800	5
	(3)	120,000	3
	(4)	134,000	1.5
	(6)	68,000	15
	(7)	66,000	22
18 nickel, 17 zinc	(8)	58,000	40
	(9)	85,000	3
18 nickel, 27 zinc	(8)	60,000	40
	(9)	105,000	3
15 nickel, 19 zinc	(8)	55,000	40
	(9)	84,000	5

NOTES:
(1) Quenched from 1200 F.
(2) Quenched from 1200 F; tempered 16 hr at 750 F.
(3) Cold worked 50%.
(4) Cold worked 80%.
(5) Quenched from 1200 F; tempered 4 hr at 930 F.
(6) Quenched from 1200 F; cold worked 50%; tempered 1 hr at 1025 F.
(7) Quenched from 1200 F; cold worked 80%; tempered 1 hr at 1025 F.
(8) Soft.
(9) Hard (37.5% reduction).

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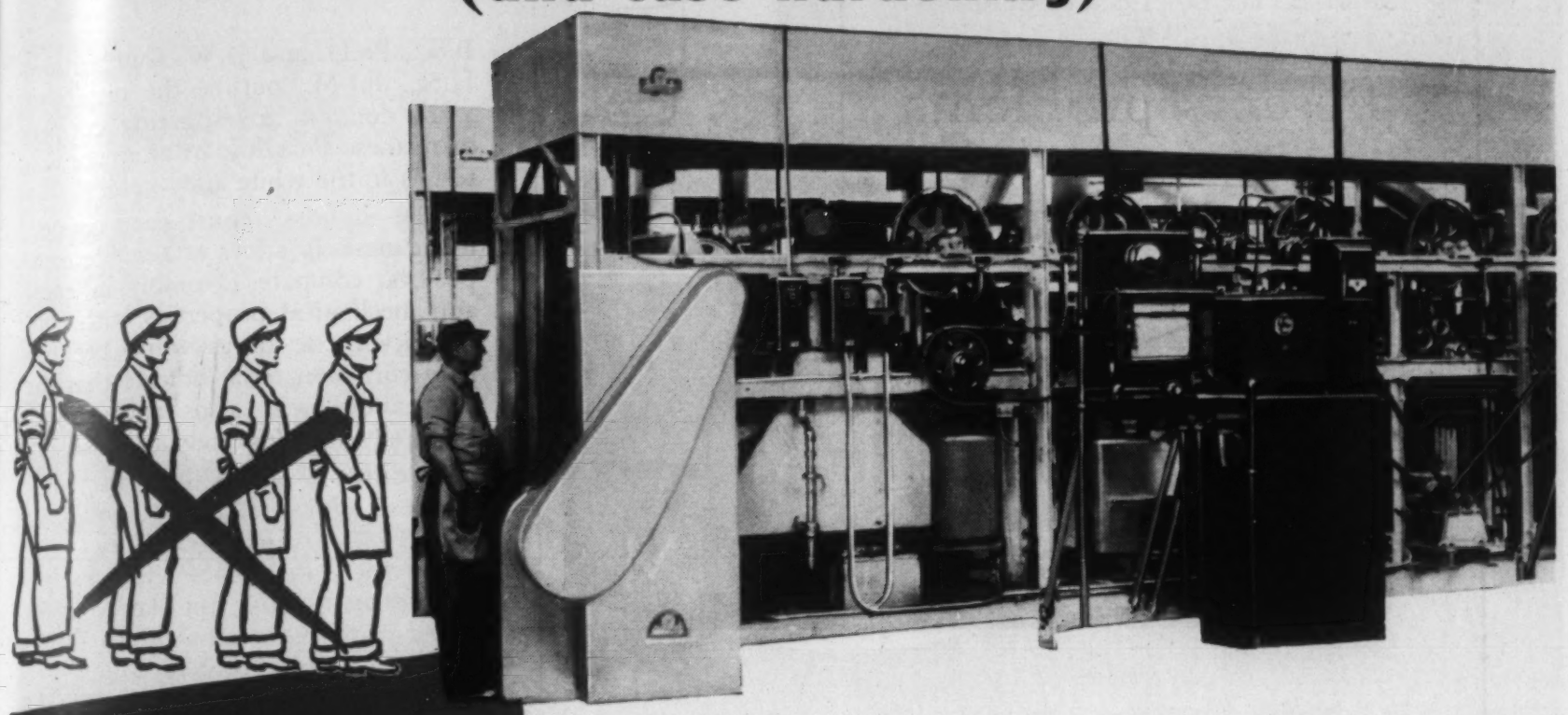

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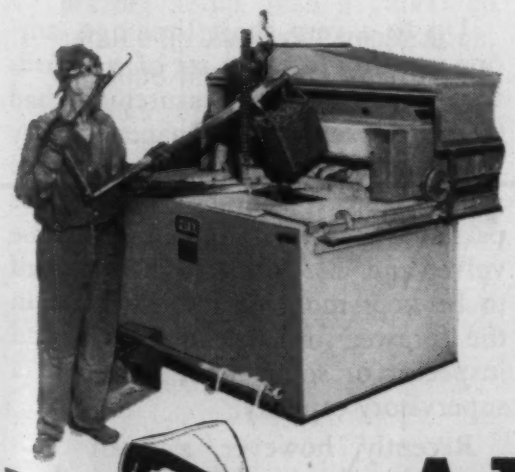

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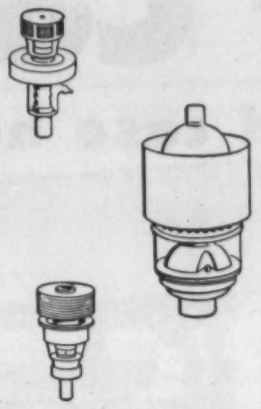

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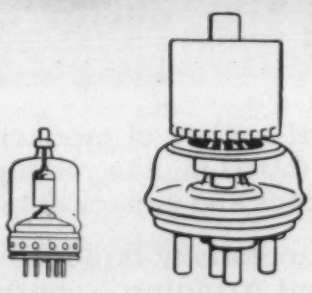

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Contents Noted | continued

B.Sc., Ph.D. and J. W. Cuthbertson, D.Sc., F.I.M., outline the results of work done in investigating copper-manganese-tin alloys as alternate materials in the white alloy field.

The authors report that copper-manganese-tin alloys of suitable composition compare favorably in color and mechanical properties with copper-nickel-zinc alloys while preliminary corrosion tests indicate that the new alloys will also meet service requirements adequately.

In order to obtain the white color in these alloys they must contain at least 15% manganese and 6% tin. With 15% manganese, alloys containing up to 10% tin can be cold-rolled with reductions up to 80%. If the manganese content is raised to 20%, the maximum tin content which will permit cold rolling to the same extent is 8%.

Although the total manganese-tin content appears to be the major factor in determining the properties of the alloys, of the two, tin seems to exert more influence than manganese.

In the accompanying table, some properties are given for two of the new alloys after various heat treatments, and for comparison, nominal properties of three nickel silvers are included.

Standards for Surface Finish Measurement

Up to a very short time ago, anyone wanting to buy a set of standards for surface finish measurement had to make a substantial financial outlay for a set of individually machined stainless steel samples. These were packed suitably enough in dark blue velvet and due to the high price had to be kept more or less inviolate in the drawer of an engineer, head inspector or some other person in a supervisory capacity.

Recently, however, a small company in this country devised a method whereby 22 surface standard samples could be electroformed as one piece and sold at such a low price that the machinist in the shop could afford to keep one in his tool box with his micrometer.

(Continued on page 260)

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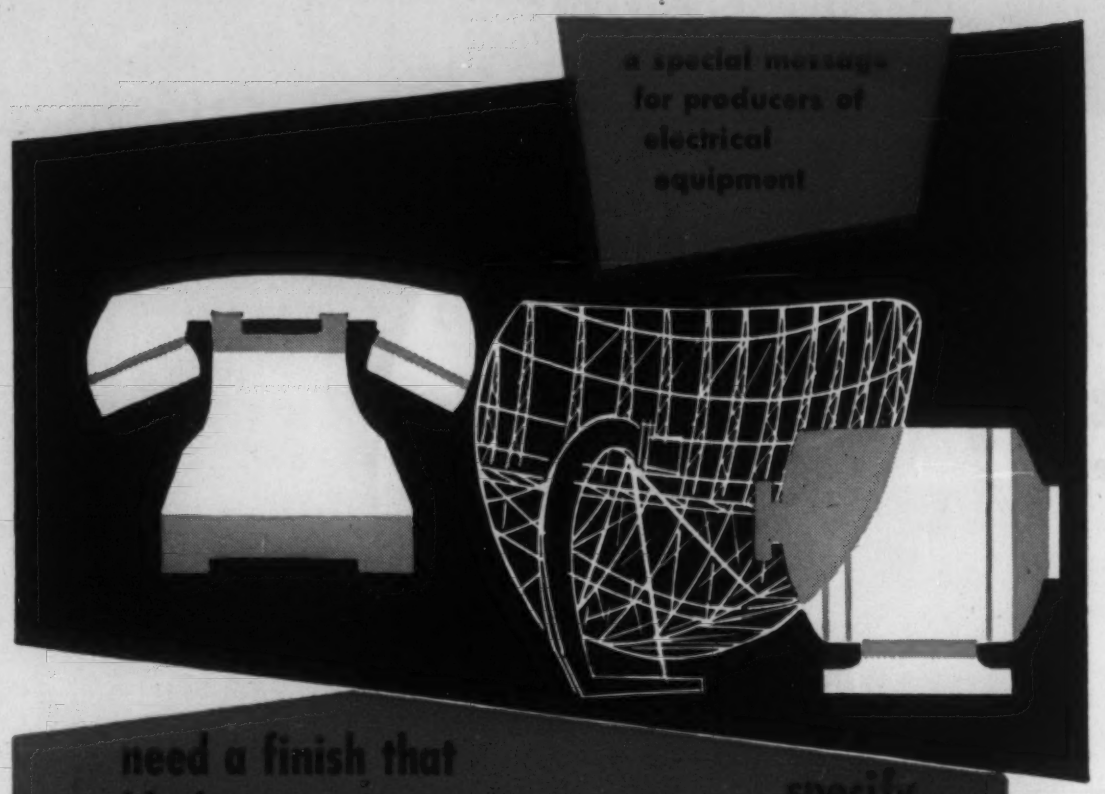

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Contents Noted | continued

It is interesting to note, in this connection, that the Russians also are using a similar method to produce surface finish standards free from the defects encountered in mechanical methods of reproduction.

In an issue of *Stank i Instr* last year, M. G. Boguslavskii explains the Russian method of "galvanizing" surface finish specimens. The master set of samples is first machined from 12 to 14% chromium stainless steel. It is then immersed in an acid solution which puts a very thin oxide film on the metal preventing further action by the solution. A coating of electrolytic nickel is then plated in thicknesses of 0.015 to 0.02 mm to form the negative, and the positive is then electrolytically formed on the negative.

From the information given, it is difficult to tell whether this method is exactly the same as the one used in this country, but it seems likely. The question then might naturally arise, which came first . . . but then, who really cares?

How Plastic Parts are Decorated

Since one of the major uses of plastics is in the consumer product field, salability is an important consideration. The selection of the method of decorating the plastic, therefore, should be made in the early stages of planning the production of the product in order to assure the optimum in pleasing appearance.

At the Tenth Annual Technical Conference of the Society of Plastics Engineers, Inc., this year, A. N. Skeels of the Art Roll Leaf Stamping Co., described the basic methods used in the industry and some of the considerations which affect the cost and the quality of the end result.

There are four basic methods of decorating plastics which are accepted by the trade, according to Skeels: hot stamping, silk screening, offset printing, and the filling-in process. Other methods, used to a lesser degree, include paper labels, decalcomanias, engraving, rubber stamping and mask spraying.

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Hot Stamping

This is the most versatile and inexpensive of the decorating methods, embodying quality, wear resistance, productivity and ease of handling. It is used on both thermoplastic and thermosetting molded products with the exception, for the most part, of urea resins, and is not used at all on the melamines.

The process is based on the coordinated use of heat, pressure and dwell time. A pigment colored leaf or foil is deposited in such a manner as to release the pigment from a clear cellophane or acetate material, so that it becomes homogeneous with the basic plastic material. It is essential, the author points out, to choose the leaf carefully, since a given type of leaf can not be used on all types of plastics.

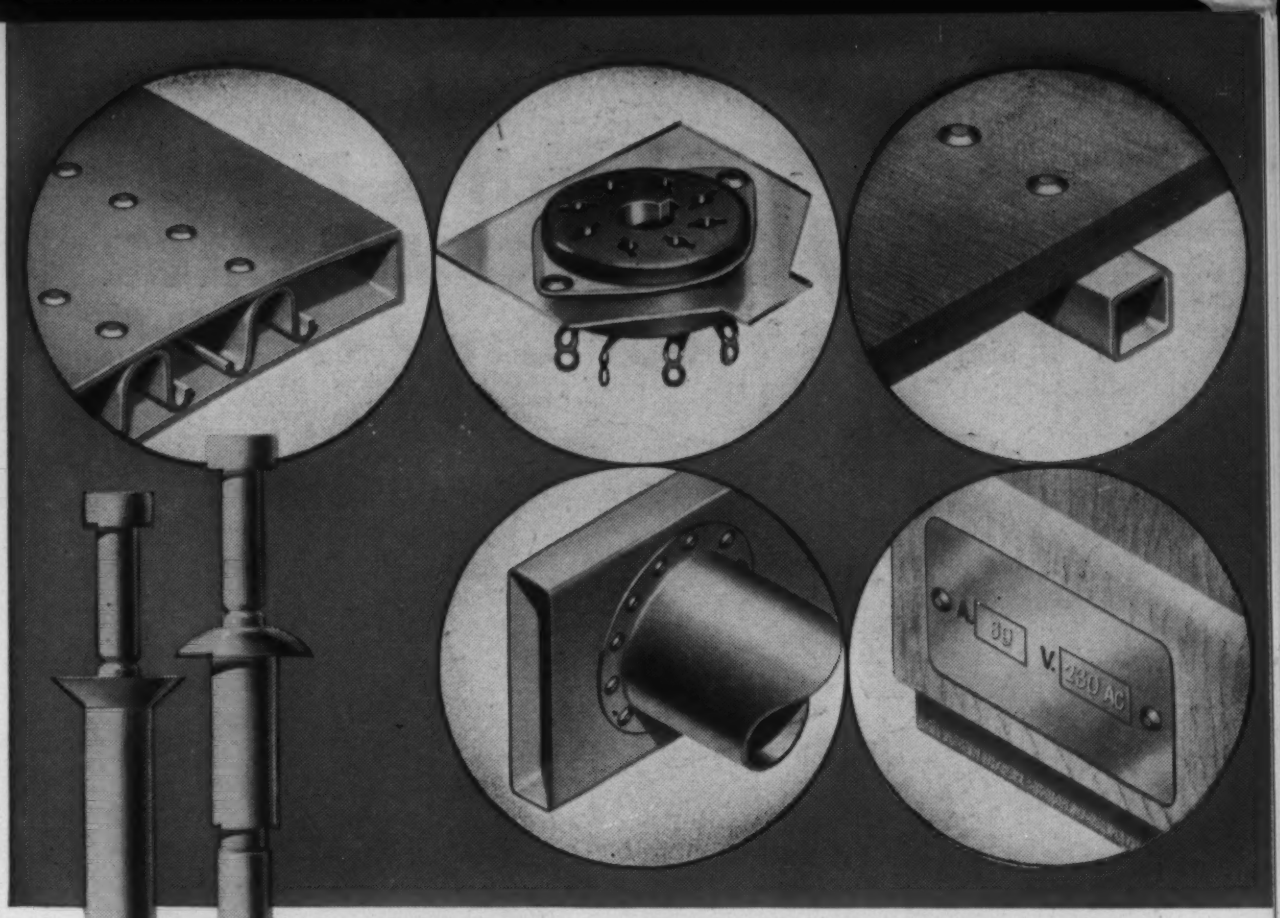
The cost of decorating by this method varies according to the type of plastic used. Some plastics will react to heat more readily than others, which varies the speed of production.

Silk Screening

The silk screening process can be used to attain quality, wear resistance and fairly good productivity at a reasonable cost on all types of plastics. The success of this method depends on the chemical action of the solvents used in the ink or paint which must bite into the specific type of plastic to be decorated. When using this process on thermosetting plastics, even though the inks or paints applied are subjected to a baking process and contain solvents which help their adhering qualities, it is recommended for best results that this type of decoration be coated with a clear lacquer or varnish. This is because thermosetting materials are almost impervious to all chemicals, and inks and paints have difficulty penetrating the base material. When subjected to constant handling or friction contact, this weak bond allows the finsh to chip or flake off.

Difficulties in the use of this process amount to selection of the proper inks or paints, correct mesh of screen and choice of film, together with the proper consistency of the rubber squeegee used in the process. One of the most difficult of these problems is securing screens with good definition as well as long life under constant production use.

(Continued on page 264)



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Contents Noted | continued

Offset Printing

Decorating with this process is performed with a smoothness, fine detail and delicacy of design which cannot be obtained in any of the other processes, according to the author. However, resulting colors are rather transparent and high rates of production are not too feasible. When printing on thermosetting resins, the same problem holds true for offset printing as with silk screening, so a coat of clear lacquer or varnish should be put on over the the finished decoration.

The problems with this process lie in the choice of proper inks and the correct type of rubber or glycerine rollers. The rubber in the roller must be impervious to the solvents in the inks. If they are not, the solvents will be absorbed by the rubber and the ink will dry before printing is completed.

Filling-In Process

This slow and often unsatisfactory process consists of molding the design into the plastic and then filling it in with colored paint or wax. Its most successful application is with thermosetting resins, though it is quite a costly method.

The other methods mentioned above are not too successful, according to Skeels, and are not often used for precision work where large quantities are desired.

The author also emphasizes the necessity for closer and more consistent dimensional tolerances in multiple cavity molds. Without these there can be no great consistency in the quality of the decorative results.

Gas Turbine Blades: Which Forming Method?

Methods used for the production of gas turbine blades are many and varied and a cause of much controversy in the engineering industry. In the December, 1953 issue of *Metal Treatment* (British), B. P. Dabell, B.Sc. (Eng.), A.M.I. Mech.E. and L. H. Williams, B.Sc., A.R.S.M. discuss the production of gas turbine blades at the Ruston & Hornsby, Ltd. plant, pointing out the advantages and disadvantages of the various methods available. They also sum-

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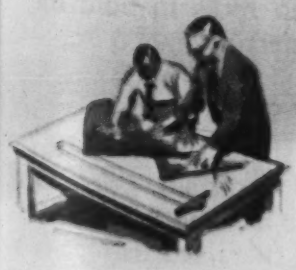

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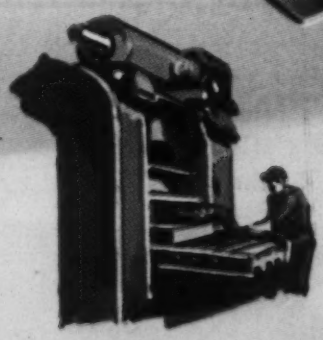

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Contents Noted | continued

marize the techniques selected at the British plant for forming both the turbine blades and the compressor blades.

Precision Investment Casting

The advantages in the use of this method are:

1. The profile is cast to finished size and requires no machining.
2. A change of design requires only a new master pattern.
3. The profile, which is the most complex and expensive part of the blade, is formed first allowing inspection to reject defective blades at this point rather than wasting further operations on "rejects".

Disadvantages:

1. Despite all precautions there is always the chance of blow holes and other casting defects.
2. The properties of some high temperature gas-turbine materials are dependent on a certain amount of hot or cold working. This cannot be given to castings.
3. Precision cast blades are not as accurate as those which are machined. With machined blades, tolerances of ± 0.003 in. are easily obtainable, while with castings, ± 0.005 in. are more practicable. Sectional displacement and twist errors are more common with castings. And with the machined blades there is also a greater consistency in variations within allowable limits than in castings.
4. Since the airfoil section is formed first, there are inherent difficulties in fixturing to machine the root.
5. Though one of the advantages in this forming method lies in the fact that inspection can reject the blade before subsequent machining operations are carried out, there are difficulties in inspecting the blade, since there are no roots to hold the blade during inspection.

Precision Forging

This method shares some of the disadvantages of precision casting, namely *4* and *5* above. When Nimonic is used, there is a danger of cracks and the possibility of scale being forged into the metal unless the blades are thoroughly cleaned after each die stage. In addition, the effect of the cold work carried out by the final coining operation is questionable from a metallurgical

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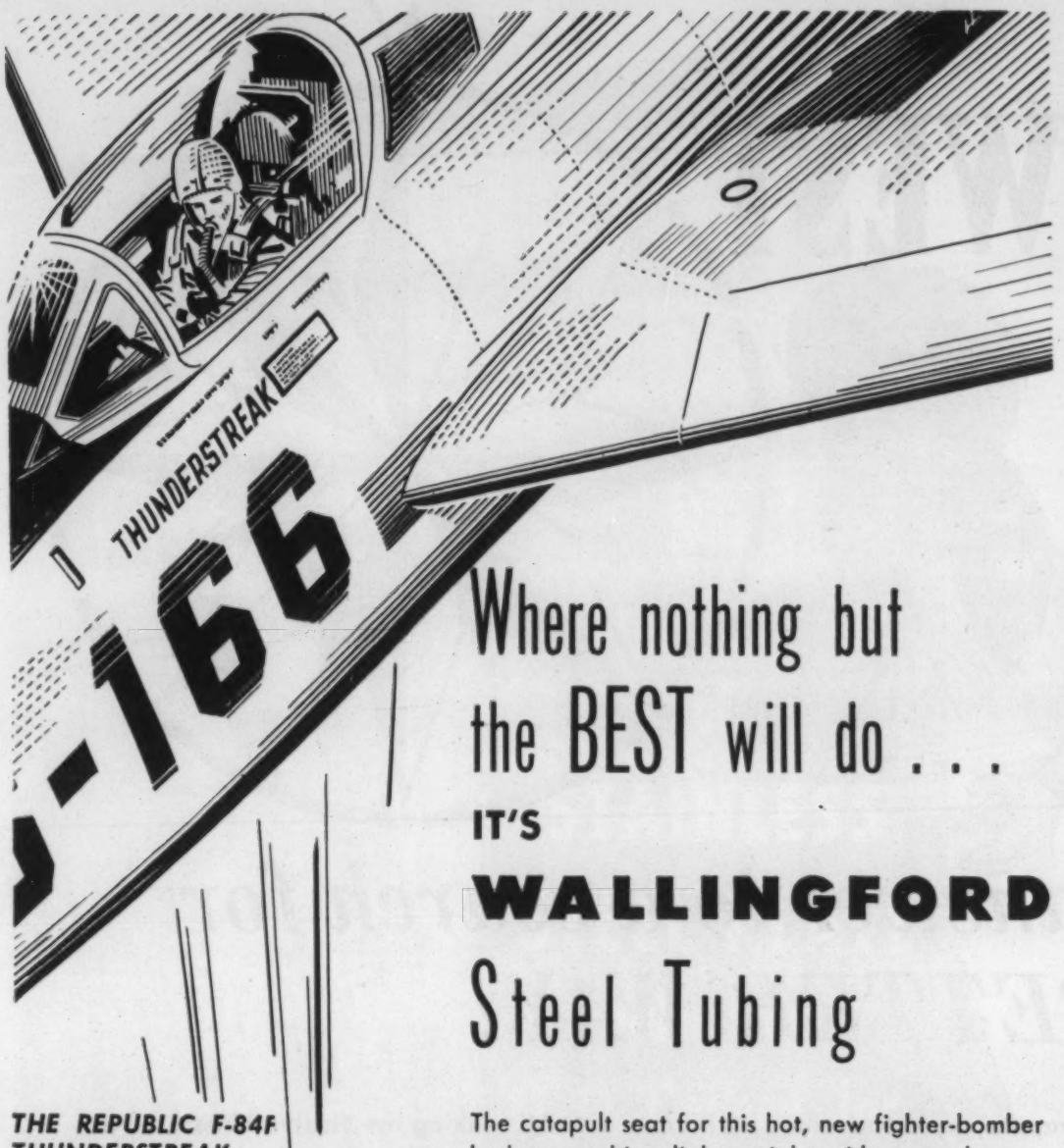

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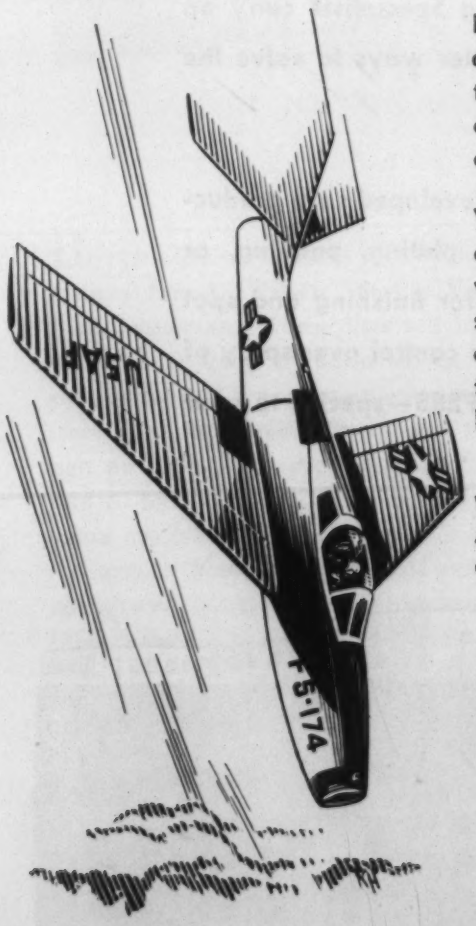

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Contents Noted | continued

point of view.

In the forming of steel compressor blades it is a different matter since the steels are easier to work, and accuracy is better with steel than with Nimonic. The authors point out that on the basis of cost, there is little choice between precision forging and machining all over.

All Over Machining

In this method either bar material or rough forgings can be used. In the latter case, the disadvantages of locating from a complex shape are less serious as only a rough location is required in order to mill a couple of flat surfaces for clamping during later operations. The main difference lies in the fact that there is a saving in material and rough machining time when parts are machined from rough forgings. However, the rough forging is more expensive than the bar stock.

On a comparative basis rough forgings lose out on the small blades, but become cheaper as the size of the blade and cost of material increases. But as pointed out by the authors, the greatest advantage in machining the blade all over from bar or forgings is that at an early stage, two flat surfaces are created that can be utilized at any point in subsequent operations for location and inspection.

It All Adds Up

The authors summarize how these pros and cons apply to the operations at the Ruston & Hornby works as follows:

1. Turbine blades are machined from Nimonic bar although the largest size could be machined from rough forgings for the same cost.

2. Compressor rotor and intermediate stator blades are machined from En 56A-Q (approximate equivalent of AISI 410) bar stock. Rough forgings offer no advantages. Precision forgings could be used at approximately the same cost but would entail the disadvantages listed above of difficulties locating and clamping the form and difficulties of inspection.

3. Compressor stator exit blades and inlet guide vanes, being small in number, larger in chord and less critical for accuracy of form are precision cast in 20:12 chromium-nickel steel.

(Book Reports on page 270)

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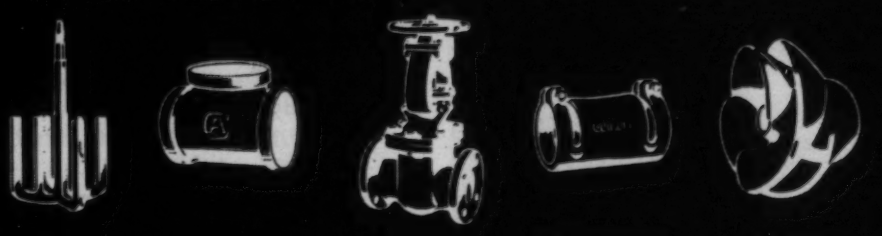

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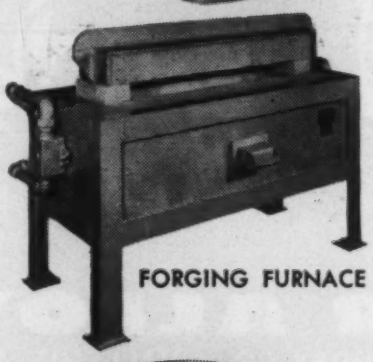

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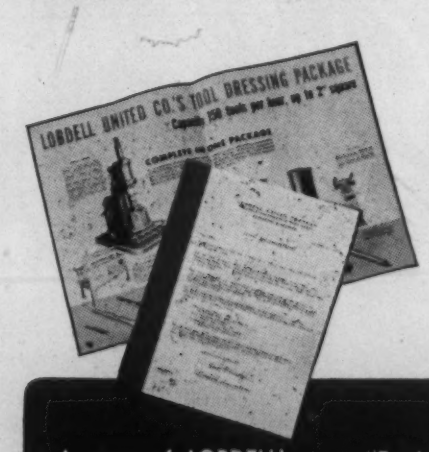

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Contents Noted | Books

Heat-Resisting Steels and Alloys. *C. G. Conway. D. Van Nostrand Co., Inc., New York, N. Y., 1954. Cloth, 6 by 9 in. 160 pp. Price $5.00.*

This is a concise data book on the high temperature properties of commercial steels and alloys produced in the United States and Great Britain. Data cover typical compositions, common uses, advantages and disadvantages, creep properties and other mechanical properties and physical properties.

The book is divided into sections covering, 1) carbon, low alloy and martensitic steels, 2) bolt steels, 3) valve steels, 4) U. S. cast steels, 5) austenitic steels of standard type and 6) special heat resisting steels and alloys of the proprietary type.

This collection of data provides a convenient reference source for engineers and designers who require information on which to base the design of components used in the construction of gas turbines, steam boilers, chemical plant equipment and other equipment to operate under stress at high temperatures.

Metallic Materials for the Machine Designer. *E. Bickel. Published by Springer-Verlag, Berlin, Germany, 1953 (in German). Cloth, 6 by 10 in. 442 pp.*

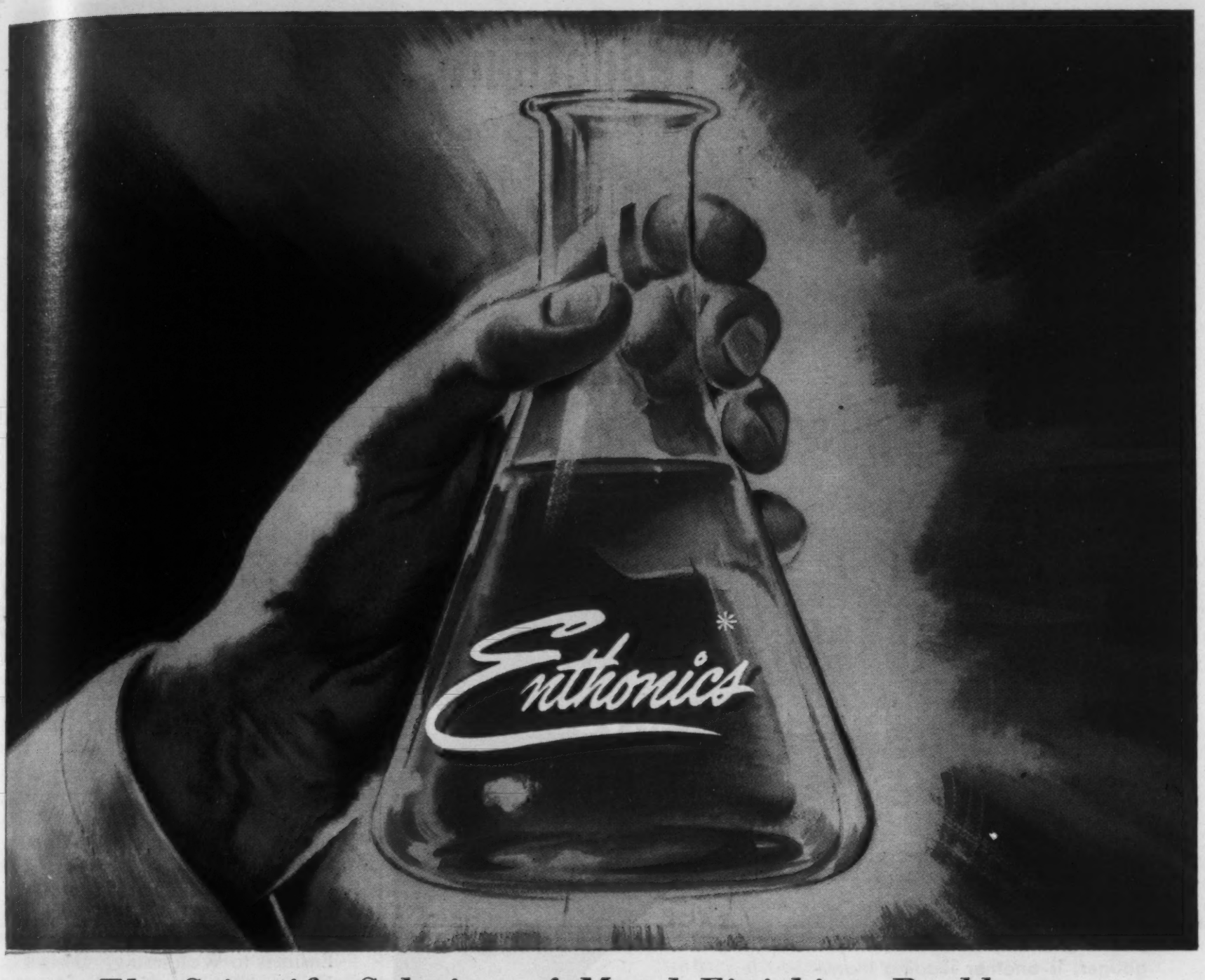
This is a textbook designed to familiarize the mechanical and electrical engineer with the properties and characteristics of metallic materials.

The structure and properties of crystals are discussed in several chapters which furnish the back-ground for a discussion of alloy equilibrium diagrams and the underlying theory of atomic structure.

A third section covers the determination and significance of the various physical and mechanical properties of materials.

The remainder of the book covers the properties of specific materials including iron and carbon steel, alloy steel, cast steel, non-ferrous metals such as copper, zinc, aluminum and magnesium, bearing metals, and metal powder products.

Specifications and Tests for Electrodeposited Metallic Coatings. *American Society for Testing Materials, Philadelphia 3, Penna., 1953.*



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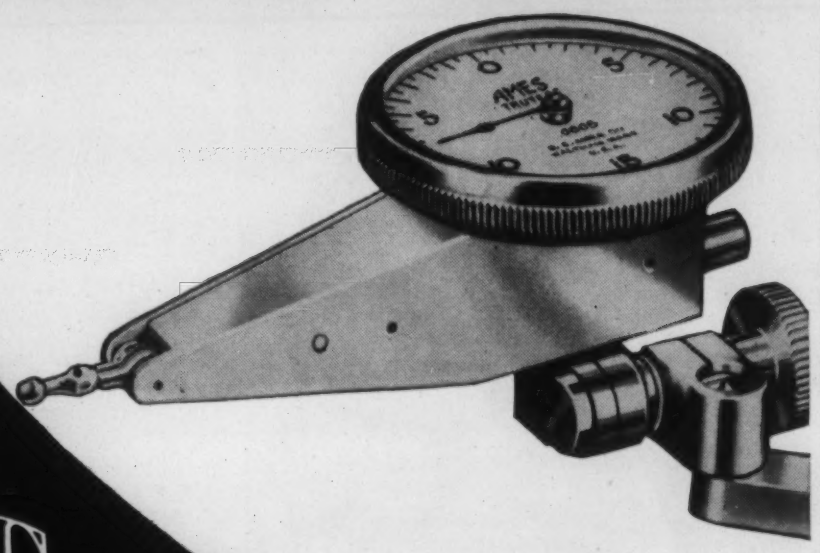

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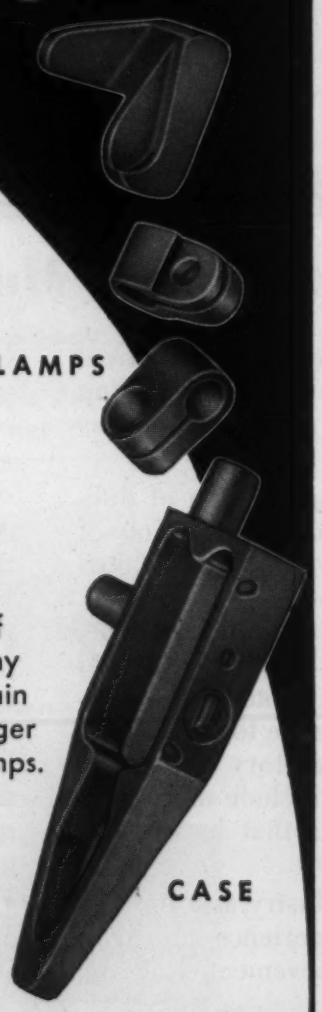

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Contents Noted | Books continued

Paper, 6 by 9 in. 96 pp. Price $1.85. This publication brings together in convenient form all of the ASTM Specifications and Methods of Test pertaining to electrodeposited metallic coatings on metals. ASTM Committee B-8 on Electrodeposited Metallic Coatings and the American Electroplaters' Society prepared jointly the specifications and tests included here.

Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials. *American Society for Testing Materials, Philadelphia 3, Penna., 1954. Paper, 6 by 9 in. 128 pp. Price $2.50.* At the 1953 annual meeting of ASTM, Committee C-22 on Porcelain Enamel sponsored a symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials. The sixteen papers presented are contained here. Titles and authors are as follows: Introduction—Dwight, G. Bennett; "Some Examples of the Functional Use of Porcelain Enamel and Ceramic Coatings," G. H. Spencer-Strong; "Resistance of Porcelain Enamels to Weathering," Dwight G. Moore; "The Chemical Resistance of Glass Fused to Steel," O. J. Britton and E. A. Sanford; "Acid Resisting Properties of Porcelain Enamels", Harold C. Wilson; "Requirements for and Expected Benefits from the Application of Coatings to High Temperature Components of a Jet Engine", Allen C. Francisco and G. M. Ault; "High Temperature Ceramic Coatings as Applied to Aircraft Power Plants", B. L. Paris; "The Industrial Processing of High-Temperature Ceramic Coatings", J. H. Terry; "A Laboratory Evaluation of Ceramic Coatings for High Temperature Applications", Sara J. Ketcham; "Abrasion Resistance of Various Types of Porcelain Enamel", A. V. Sharon; "The Resistance of Porcelain Enamels to Surface Abrasion As Determined by the PEI Test", John T. Roberts; "Torsion Testing as an Aid to the Porcelain Enamel Industry", Earl Hoover; "The Strengthening Effect of Porcelain Enamel on Sheet Iron as Indicated by Bending Tests", E. E. Bryant; "Tension Tests of Porcelain Enameled Steels", W. A. Deringer; "The Effect of Temperature on the

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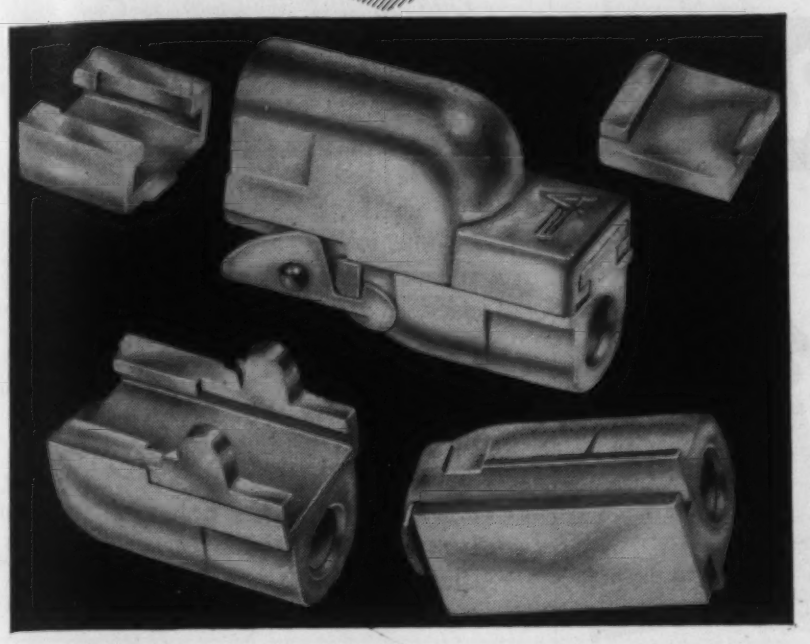

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D. L. Blyth, Tyer Sales Engineer, and Albert I. Alstrom, Product Engineer, Wico Electric Company, West Springfield, Mass., examine custom molded rubber parts.

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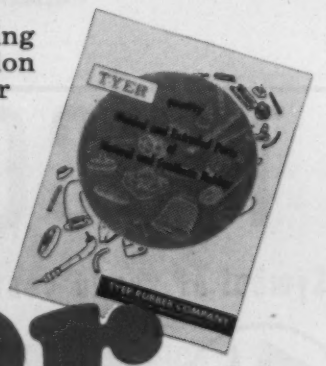

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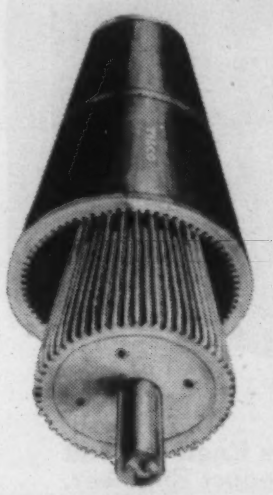

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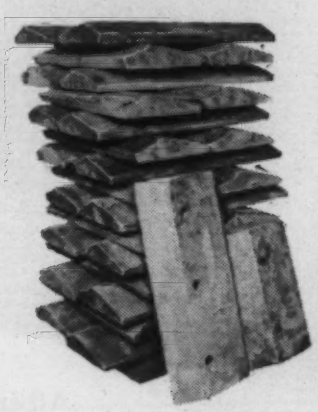

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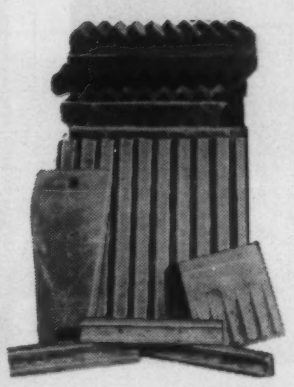

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Contents Noted | Books continued

Electrical Resistivity of Several Silicone and Ceramic-Type Coatings", Simon W. Strauss, Lloyd E. Richards and D. G. Moore; "Guideposts in Selecting Porcelain Enamels and Ceramic Coatings" — Summary, W. N. Harrison.

Mechanics of Materials. *Philip G. Laurson and William J. Cox. John Wiley & Sons, Inc., New York 16, N. Y., 1954. Cloth, 6 by 9 in. 414 pp. Price $5.75.* This third edition is designed for use in the standard courses in mechanics of materials of one term, one semester, or one year. The first fourteen chapters deal with principles and methods used in the design of ordinary structural and machine parts, and specialized material is contained in the later chapters. The physical behavior of stressed bodies has been emphasized as well as the mathematical expression of this behavior. Attention has been given too, to outlining the principles that govern the determination of allowable stresses.

The Closed Die Forging Process. *P. E. Kyle. The Macmillan Co., New York, N. Y., 1954. Cloth, 5½ by 8 in. 140 pp. Price $1.50.* Discussed here are the essential steps in producing drop forgings and some of the uses to which closed die forgings can be adapted. Also covered to some extent are the properties of forged metals and the fundamentals of hot working. This book will serve as a valuable supplement to any text being used for a course devoted specifically to forging practices and may also prove helpful in machine design courses where formal instruction in metal processing may not have preceeded the course. Design engineers and users of forgings will also find the book useful.

Resistance Welding of Miscellaneous and Dissimilar Metals. *Resistance Welder Manufacturers' Ass'n., Philadelphia 2, Penna., 1954. Price 10¢.* This Bulletin, Number 19, covers information on the spot, seam and flash welding of titanium, cobalt-base alloys and refractory metals, as well as zinc and zinc die castings, lead and lead alloys and dissimilar metals. The Bulletin also contains a number of tables and photographs.

(Reports on page 276)

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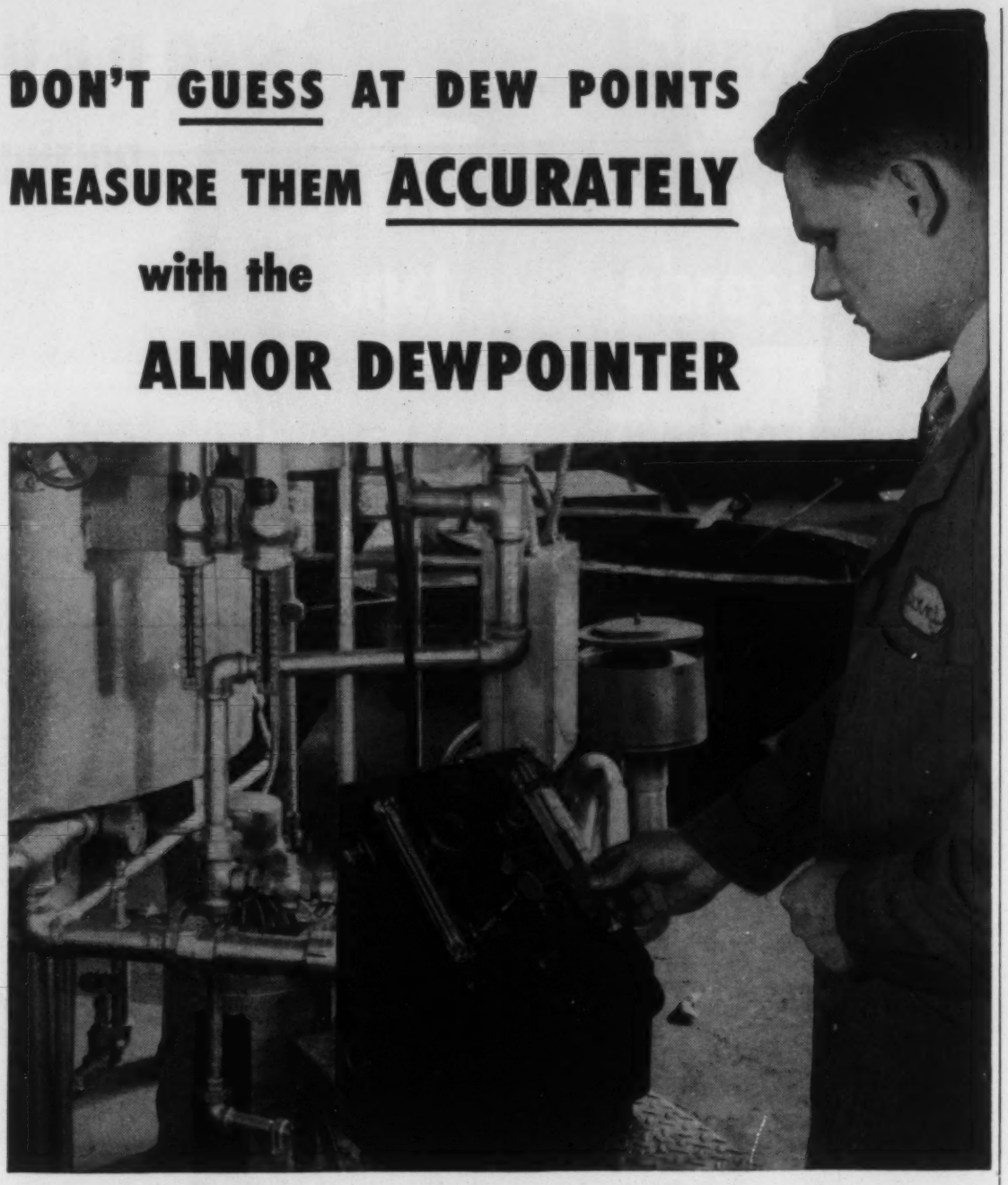

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Contents Noted | Reports

Properties of Ferrites Measurement of the Microwave Properties of Ferrites at High Power Levels. *David Levine and John L. Carter, U. S. Camp Evans Signal Laboratory, Belmar, N. J., Nov. 1953. PB 112990, 19 pp, diagrams, graphs. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $1.75, photostat $2.50.* Report details experimental investigation to determine the properties of ferrites at high power levels. Measurements have also been made of the relationship between frequency and the geometry of different samples of ferrite materials.

Shell Molding Shell Molding Process. Progress Report No. 1 on Application to the Manufacture of Steel Turbine Blades. *L. S. Denning, U. S. Naval Shipyard, N. Y., Material Laboratory, Apr. 1952. PB 113103, 6 pp, photographs. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $1.25, photostat $1.25. Progress Report No. 2, PB 111004.*

Plastics for Bonding of Mold Sands Utilization of Plastic-Bonded Sands for Molds and Cores. *U. S. Naval Shipyard, N. Y., Material Laboratory, Feb. 1950. PB 113102, 28 pp, photographs, drawings. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $2.00, photostat $3.75.* Covers the subject from the standpoint of materials used in casting, or casting molds, and precision casting.

High Temperature Corrosion Abstract Compilation of the Literature on High Temperature Oxidation of Metals. *W. Martin Fassell, Jr., Martha S. Chamberlain, Robert C. Peterson, University of Utah, Department of Metallurgy. Under Contract DA-04-495-ORD-237. Order separate parts described below from Library of Congress, Publication Board Project, Wash. 25, D. C., giving PB number of each part ordered.*

Technical Report No. III, Part I. n.d. PB 113029, 353 pp, Microfilm $9.00, photostat $45.00.

Technical Report No. III, Part II. n.d. PB 113030, 319 pp. Microfilm $9.00, photostat $40.00.

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Contents Noted | Reports continued

Pipelines and Storage Tanks. *V. A. Pritula, Great Britain Department of Scientific and Industrial Research, Oct. 1953. PB 112844, 166 pp, drawings, diagrams, graphs, tables. Available from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. $2.25.* Translated from the Russian original published in 1950.

Titanium Frictional Properties of Titanium and Its Alloys. Annual Progress Report, Nov. 1, 1952 to Dec. 31, 1953. *E. Rabinowicz, Massachusetts Institute of Technology, Department of Mechanical Engineering, Lubrication Laboratory, Jan. 1954. PB 113071, 37 pp, diagrams, graphs, tables. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $2.25, photostat $5.00.*

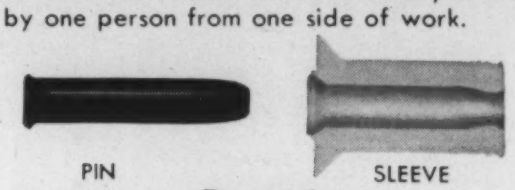
Influence of Surface Treatment on the Fatigue Properties of Titanium and Titanium Alloys. *L. Thomassen, M. J. Sinnott, A. W. Demmler, Jr., University of Michigan Engineering Research Institute, Ann Arbor, Mich., Feb. 1953. PB 112962, 11 pp, graphs, tables. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $1.75, photostat $2.50.* Report evaluates four different subsurface treatments for Ti-75A, and their effect on the fatigue properties.

Fretting Corrosion Fundamental Investigation of Fretting Corrosion. *H. H. Uhlig, I. Ming Feng, W. D. Tierney, and A. McClellan, U. S. National Advisory Committee for Aeronautics, Dec. 1953. PB 112865, 52 pp, diagrams, graphs, tables. Available from National Advisory Committee for Aeronautics, 1724 "F" St., N. W., Wash. 25, D. C.* Part I describes test machine for measuring fretting damage. Part II presents data for mild steel fretted against itself, with consideration being given to the effect of humidity, temperature, test duration, atmosphere, relative slip, pressure and frequency. Part III suggests a mechanism for the fretting process.

High Strength Cast Steel High-strength Cast Steel for Navy Anchors. *R. H. Raring, U. S. Naval Research Laboratory, Apr. 1949. PB 112920, 18 pp, photos, graph, tables. Available from Library of Congress, Pub-*

EXTRA!

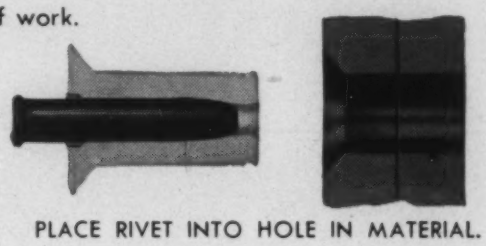
Huck Manufacturing Company announces the high shear, high tensile, heat resisting and corrosion resistant stainless steel Deutsch drive pin blind rivet that can be installed with an ordinary hammer by one person from one side of work.



Deutsch
Drive Pin Blind Rivet Features

1. Drive with ordinary hammer.

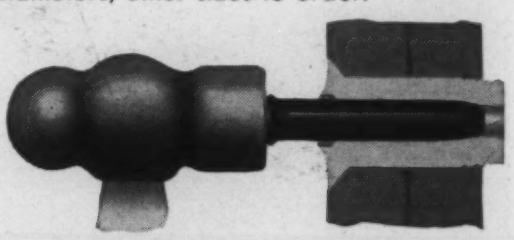
2. Installed by one person from one side of work.



PLACE RIVET INTO HOLE IN MATERIAL.

3. Available from stock in both countersunk and brazier heads.

4. Stocked in 3/16", 1/4", 5/16" and 3/8" diameters, other sizes to order.

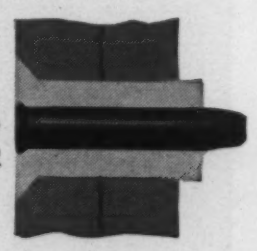


DRIVE RIVET PIN WITH HAMMER.

5. High shear strength—75,000 PSI minimum guaranteed.

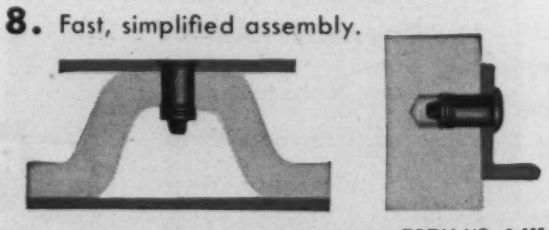
6. High tensile strength, excellent sealing qualities and low weight.

PIN DRIVEN, SLEEVE EXPANDED TO FORM BLIND HEAD, AND PIN LOCKED IN SLEEVE.



7. Heat and corrosion resistant.

8. Fast, simplified assembly.



FORM NO. 8-265

Deutsch Drive Pin Blind Rivets can be used in buried rivet applications, double construction or wherever you want a simple, strong and dependable blind rivet. When you think of fasteners, think of

Huck MANUFACTURING COMPANY
2480 BELLEVUE AVE., DETROIT 7, MICH.

For more information, Circle No. 338

A viewing hood for an oscilloscope seems like a simple problem for the rubber technologist, yet it is significant that Tektronix, Inc., of Portland, had Roth Rubber, in Chicago, provide the solution. The viewing hood must not crack or buckle, has to adjust to any face and must exactly fit the Tektronix scope. Roth engineers solved this problem—they can solve *yours.*

Engineers and Rubber Buyers!

Write for your free Roth Rubber Sampler. This unusual kit contains actual rubber samples with hardness from 5 to 100 Durometer . . . gives ASTM specs and lists uses for each sample. Sorry, but offer must be limited to engineers and rubber buyers only. Please ask for Roth Rubber Sampler No. MM1.

Custom Manufacturers of Industrial Rubber Products since 1923.

ROTH RUBBER COMPANY

7856 S. 54th Avenue, Chicago 50

Send Roth Manual
Please comment on attached description of our rubber problem or production rubber requirements.

Name_____

Position_____

Company_____

Address_____

City_____ Zone___ State____

Contents Noted

Reports continued

lication Board Project, Wash. 25, D. C. Microfilm $1.75, photostat $2.50. Report covers investigation of cast steel specimens (and heat treatment) which will have the yield strength of 80,000 psi without use of potentially scarce materials or liquid quenching.

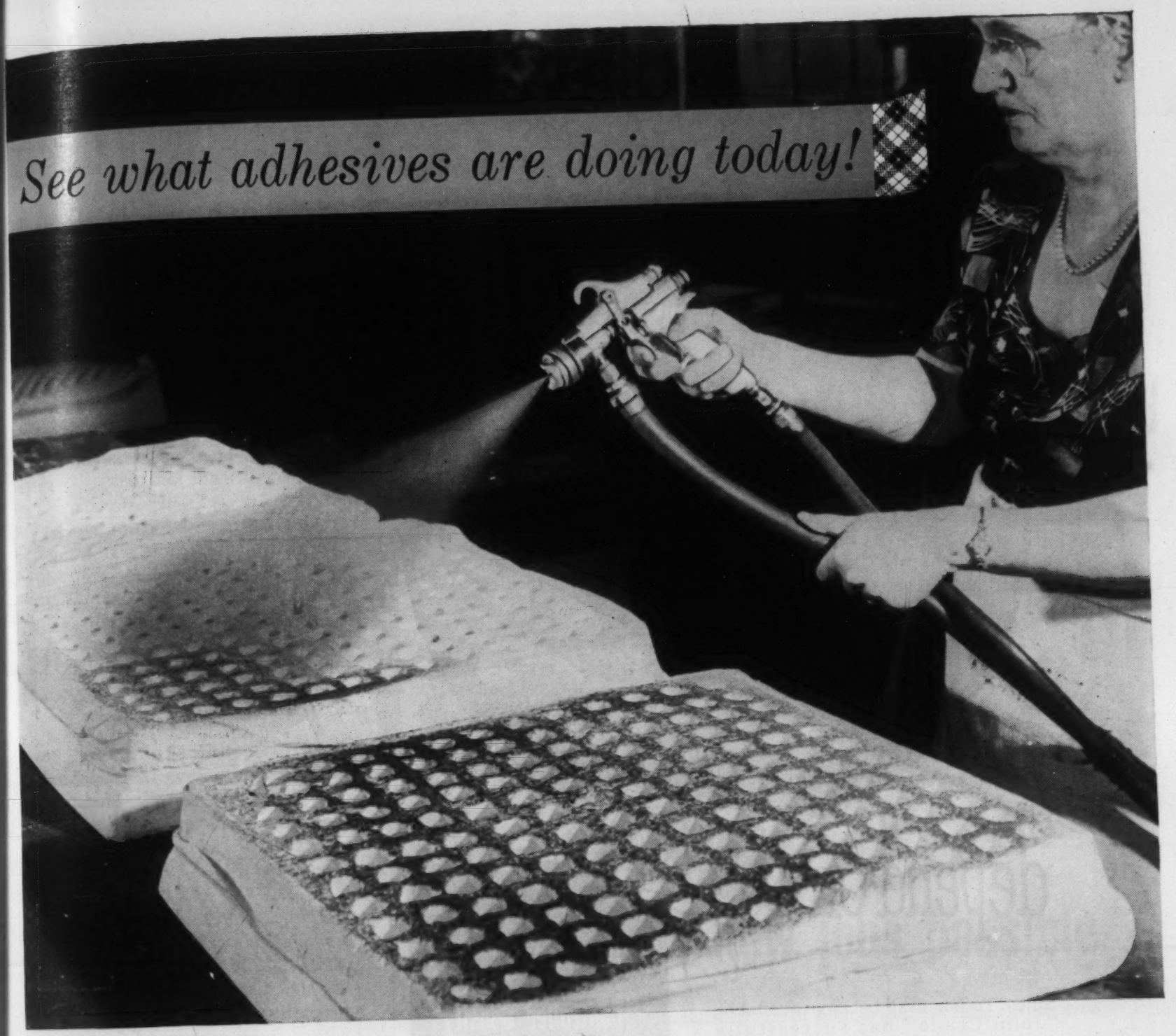
Shock Resistance of Aluminum Castings Resistance of Cast Aluminum Alloys to Mechanical Shock. *Bernard Goldberg, U. S. Naval Research Laboratory, Nov. 1948. PB 113036, 21 pp, photographs, diagrams, graphs, tables. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $2.00, photostat $3.75.* Six different sand cast aluminum alloys, cast iron and mild steel. Comparison of mechanical shock resistance of materials in relation to resistance to fracture for a small number of cycles of strain was obtained. Methods for determining shock resistance of materials were developed.

Improved Butyl Rubber Compounds Research Investigations Leading to the Development of Improved Butyl Rubber Compounds. Quarterly Report No. 1 for Quarter Ending May 31, 1951. *L. J. Rad, N. G. Britt and B. Schwartz, Interchemical Corporation, Research Laboratories, New York, N.Y., June 1951. PB 113014, 35 pp, photographs, graphs, tables. Available from Library of Congress, Publication Board Project, Wash. 25, D.C. Microfilm $2.25, photostat $5.00.* Covers production of butyl and synthetic rubbers, propane, and polymers of methyl. Also tests of properties of various polymers.

Sandwich Structure Investigation of Sandwich Construction Under Lateral and Axial Loads. *Wilhelmina D. Kroll, Leonard Mordfin and William A. Garland, U.S. National Advisory Committee for Aeronautics, Dec. 1953. PB 112872, 58 pp. photographs, diagrams, graphs, tables. Available from National Advisory Committee for Aeronautics, 1724 "F" St., N.W., Wash. 25, D.C.* Tests under these load conditions were made on sandwich panels with simply supported loaded edges and free unloaded edges to determine the strength of panels of various thicknesses and to compare the results with computed values.

(More Reports on page 282)

For more information, turn to Reader Service Card, Circle No. 498



Setting seating for greater comfort

At the Flxible Coach Company in Millersburg, Ohio, they take great pride in the comfort of the vehicles they build.

They take great care, too, in making this comfort a lifelong feature. They use foam rubber cushioning for bus seats. And to help hold these cushions firmly in place they use a 3M adhesive, EC-164.

EC-164 secures a cloth shield backing to the rubber cushions. It also bonds the backed cushion to the metal bus seat. By using 3M adhesives instead of other fastening methods, Flxible has managed to improve the appearance and service of the finished product, and to cut production costs.

See what adhesives can do for you . . . Flxible makes use of 3M adhesives in many ways. Have you considered 3M adhesives for your jobs? Your 3M sales engineer will be glad to discuss this with you. Call him in. For a free, informative booklet, write today. Address request to 3M, Dept. 65, 417 Piquette Ave., Detroit 2, Michigan.

see our catalog in PRODUCT DESIGN FILE or write for copy

3M COMPANY

ADHESIVES AND COATINGS DIVISION **MINNESOTA MINING AND MANUFACTURING COMPANY**

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MAKERS OF **"SCOTCH"** BRAND PRESSURE-SENSITIVE ADHESIVE TAPES • **"SCOTCH"** BRAND SOUND-RECORDING TAPE • **"SCOTCHLITE"** BRAND REFLECTIVE SHEETINGS • **"3M"** ABRASIVE PAPER AND CLOTH • **"3M"** ADHESIVES AND COATINGS • **"3M"** ROOFING GRANULES • **"3M"** CHEMICALS

REG. U. S. PAT. OFF.

For more information, turn to Reader Service Card, Circle No. 469

for the best in TEFLON*

depend on JOHN CRANE

- Uniformity
- Controlled Density
- Product Purity
- Accurate Dimension

Since Teflon first became available, "John Crane" has successfully engineered its application to solve innumerable and widely varying problems. Typical of this is the development of packings and other products for handling corrosive liquids and gases. Other important examples include production of electronic parts of high dielectric strength and low loss factor for vhf. uhf. and microwave insulation; also in the employment of its anti-stick characteristics in the handling of adhesive materials.

These and other application developments are closely tied with "John Crane's" fabricating technique, which has resulted in Teflon products of the finest uniformity, controlled density, product purity and accurate dimension.

Teflon is available in rods, tubing or sheets or in special molded and machined forms such as bellows, "C-V" Rings, braided packings, valve discs, electrical parts, washers. dough sheeting rolls, heat sealing jaws and countless other forms. Glass, carbon or graphite filled Teflon is also available.

Consult "John Crane" on your requirements. Send for 12-page illustrated catalog, *The Best in Teflon*, containing important data and suggested applications. Crane Packing Company, 1827 Belle Plaine Ave., Chicago 13, Ill.

*DuPont trademark

JOHN CRANE CRANE PACKING COMPANY

For more information, turn to Reader Service Card, Circle No. 495

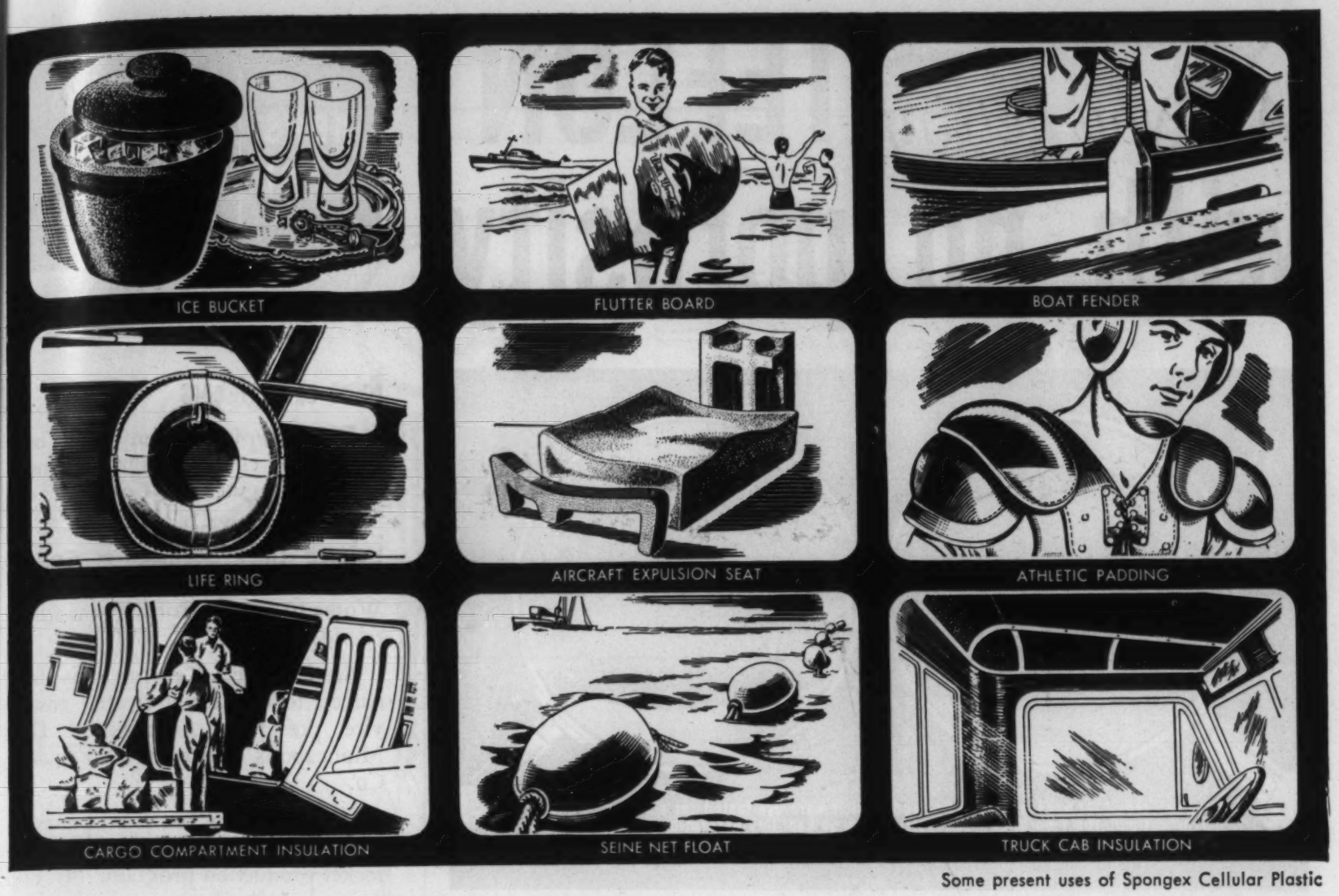
Contents Noted

Reports continued

Effects of Designs on Aluminum Castings Additional Fatigue Tests of Effects of Design Details in 355-T6 Sand-Cast Aluminum Alloy. *I. D. Eaton and John A. Youra, Aluminum Company of America, Mar. 1954. NACA RM 53L22, 24 pp, diagrams, photographs, tables. Available from National Advisory Committee for Aeronautics, 1724 "F" St., N. W., Wash. 25, D. C.* Direct stress fatigue tests were made on plate-type specimens with a single 1-in. dia as-cast cored hole and on specimens in which the cored hole was reamed to 1-1/16-in. dia. In addition, direct stress fatigue tests were made on 0.300-in. dia specimens with various degrees of porosity. Comparisons are made with results of earlier tests with variations in design details such as bosses and ribs.

Freeze-Casting Refractory Powders Preliminary Investigation of the "Freeze-Casting" Method for Forming Refractory Powders. *W. A. Maxwell, R. S. Gurnick, and A. C. Francisco, Mar. 1954. NACA RM E53L21, 19 pp, diagrams, photographs, 2 tables. Available from National Advisory Committee for Aeronautics, 1724 "F" St., N. W., Wash. 25, D. C.* The method consists in preparing an extremely thick slip with a small amount of binder, casting the slip into a mold, and freezing to retain the shape of the casting. It is then dried and may subsequently be sintered by conventional means.

Crazing of Polymethyl Methacrylate Effects of Molecular Weight on Crazing and Tensile Properties of Polymethyl Methacrylate. *I. Wolock, M. A. Sherman, and B. M. Axilrod, National Bureau of Standards, Feb. 1954. NACA RM 54A04, 11 pp, diagrams, tables. Available from National Advisory Committee for Aeronautics, 1724 "F" St., N. W., Wash. 25, D. C.* Both stress and stress-solvent tests were carried out on five cast polymethyl-methacrylate sheets in which the molecular weight of the resin was 90,000, 120,000, 200,000, 490,000, and 3,160,000. The tensile strength and ultimate elongation increased rapidly with increasing molecular weight up to around 200,000 and 500,000, where it tended to level off. No change in modulus of elasticity occurred. Stress and strain at which crazing occurred increased with increasing molecular weights.



Some present uses of Spongex Cellular Plastic

New material does old jobs better ... makes new jobs possible

Spongex cellular plastic (expanded unicellular poley-vinyl chloride) performs outstandingly as a protective cushioning, flotation or insulation material.

This new material absorbs shocks with little, if any, rebound. Its light weight and ruggedness make it just about ideal for use in the aircraft, automotive and marine fields.

Perhaps Spongex cellular plastic offers a solution to one of your problems. Write to us today for complete information. We'll be glad to help.

Properties of Spongex Cellular Plastic

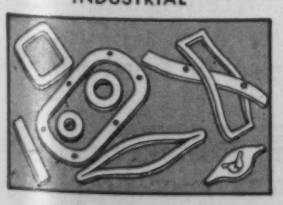
Insulates • Floats • Cushions • Low water absorption • Absorbs shock with minimum rebound • Unaffected by salt water or sunlight • Unaffected by oils, acids, perspiration • Fire-retardant • Has K factor of .20 • Needs no paint, finish or protective cover • Can be cut or molded to shape • Won't absorb odors • Non-staining • Lightweight • Non-toxic.

SPONGEX® *Cellular Materials*

THE SPONGE RUBBER PRODUCTS COMPANY, 25 Derby Place, Shelton, Connecticut

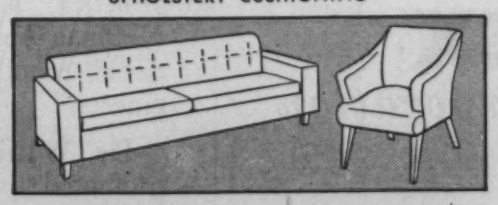
In Canada: Canadian Sponge Rubber Products, Ltd., Waterville, Quebec

INDUSTRIAL



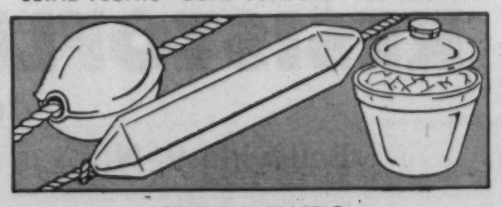
CELLULAR RUBBER

UPHOLSTERY CUSHIONING



TEXLITE RUBBERIZED HAIR—TEXFOAM

SEINE FLOATS—BOAT FENDERS—ICE BUCKETS



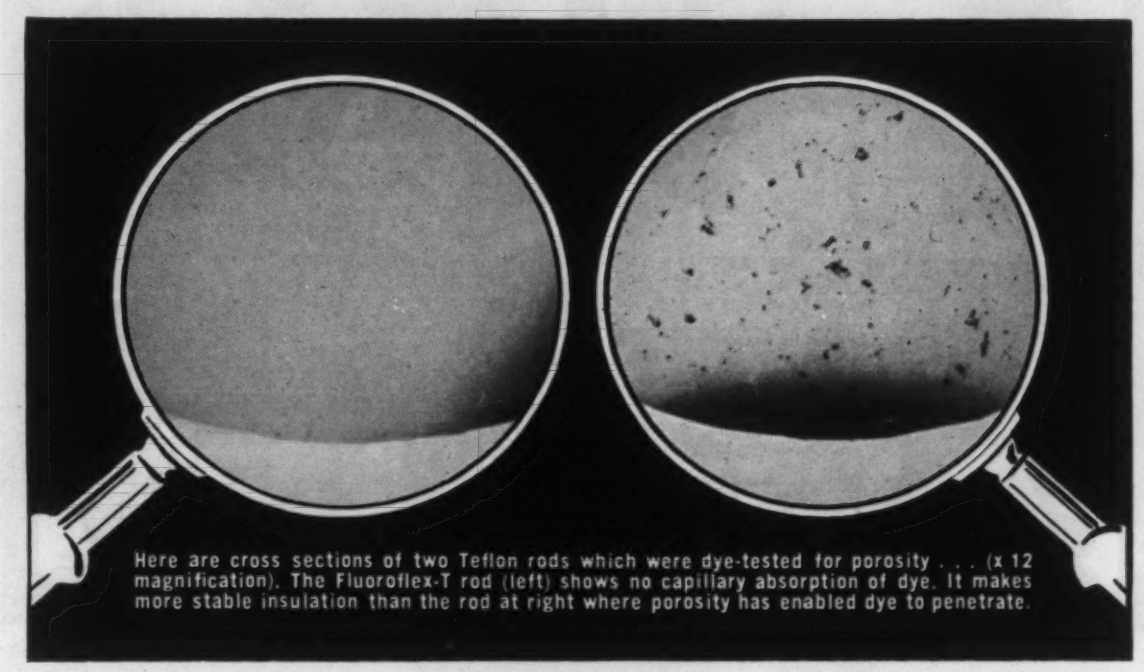
CELLULAR PLASTIC

HOME AND OFFICE

RUG CUSHION

For more information, turn to Reader Service Card, Circle No. 322

Are you getting TEFLON* *with no porosity*



Here are cross sections of two Teflon rods which were dye-tested for porosity . . . (x 12 magnification). The Fluoroflex-T rod (left) shows no capillary absorption of dye. It makes more stable insulation than the rod at right where porosity has enabled dye to penetrate.

Non-porous **FLUOROFLEX®-T** *rod, tube, sheet assure optimum electrical stability in parts*

At its optimum electrical values, Teflon is virtually the perfect dielectric material for UHF use. If, during extrusion or molding, however, a high degree of porosity results, dielectric strength, power factor and dielectric constant are bound to be affected. That's because *porous* insulation means *absorbent* insulators.

As the above photographs show, Fluoroflex-T is *non-porous*. This is achieved in two ways. (1) By processing on equipment especially designed to compact Teflon powder to the critical density. (2) By not bleaching out Teflon's natural spotting at the expense of optimum density.

Fluoroflex-T products are also stress relieved. Result: Non-porous rods, tubes, and sheets that not only give greater electrical stability but also *dimensional* stability and fewer rejects in machining. Write for Bulletin FT-1.

**DuPont trade mark for its tetrafluoroethylene resin.*
® Resistoflex trade mark for products from fluorocarbon resins.

RESISTOFLEX
corporation
Belleville 9, N. J.

SPECIALLY ENGINEERED FLEXIBLE RESISTANT PRODUCTS FOR INDUSTRY

For more information, turn to Reader Service Card, Circle No. 508

news of ENGINEERS COMPANIES SOCIETIES

News of Engineers

Dr. Joseph Remenyi has been appointed chief design engineer, Waldrip Engineering Co.

James K. Watkins has been appointed chief engineer at Crucible Steel Co. of America's Midland, Pa., Works to succeed **John Ferm** who is retiring.

Stephen F. Keating has been named to the newly created post of vice president, Aeronautical Div., Minneapolis - Honeywell Regulator Co.

Vincent Prus has been placed in charge of Goodyear Aircraft Corp.'s rocket production program. Mr. Prus succeeds **J. A. Keenan** who has been placed in charge of special production assignments.

Robert S. Ames, manager of canopy and laminates operations at Goodyear Aircraft Corp. since 1951, has been reappointed to the Subcommittee on Aircraft Structural Materials organized by the National Advisory Committee for Aeronautics.

Dr. Edward A. Kern has been appointed manager-engineering for General Electric Co.'s Silicone Products Dept. Dr. Kern was previously manager-Materials and Processes Laboratory at the company's Pittsfield works.

John V. Schmitz has been appointed product engineer, Chemical Materials Dept., General Electric Co.

George W. Knapp has been appointed manager of engineering practices, **Charles J. Meloun,** manager of paper and textile engineering, and **J. J. William Brown,** manager of materials, handling and testing equipment engineering, in General Electric Co.'s Industrial Engineering Section.

Edgar H. Dix, Jr., assistant director of research, Aluminum Co. of America, has received the Frank Newman Speller Award of the National Association of Corrosion Engineers.

Dr. William Rostoker has been promoted to supervisor of physical metallurgy, **Dr. Donald J. McPher-**

Need pins, pivots, mandrels, or other small parts? Need them in fine micro-finishes and tolerances in tenths . . . in special sizes and types to fit your product designs?

Torrington produces a wide variety of parts to customers' exact specifications . . . *faster, better and for less* than you can make them in your own plant. Why not let Torrington apply their many years of experience to *your* problems and have their special automatic machinery work for you?

Send for our Condensed Catalog. It shows many more of the parts we can produce economically for you. And send us a sample part or blueprint for our quotation—it can save you money.

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Specialties Division
777 Field Street, Torrington, Conn.

TORRINGTON *SPECIAL* **METAL PARTS**

Makers of Torrington Needle Bearings

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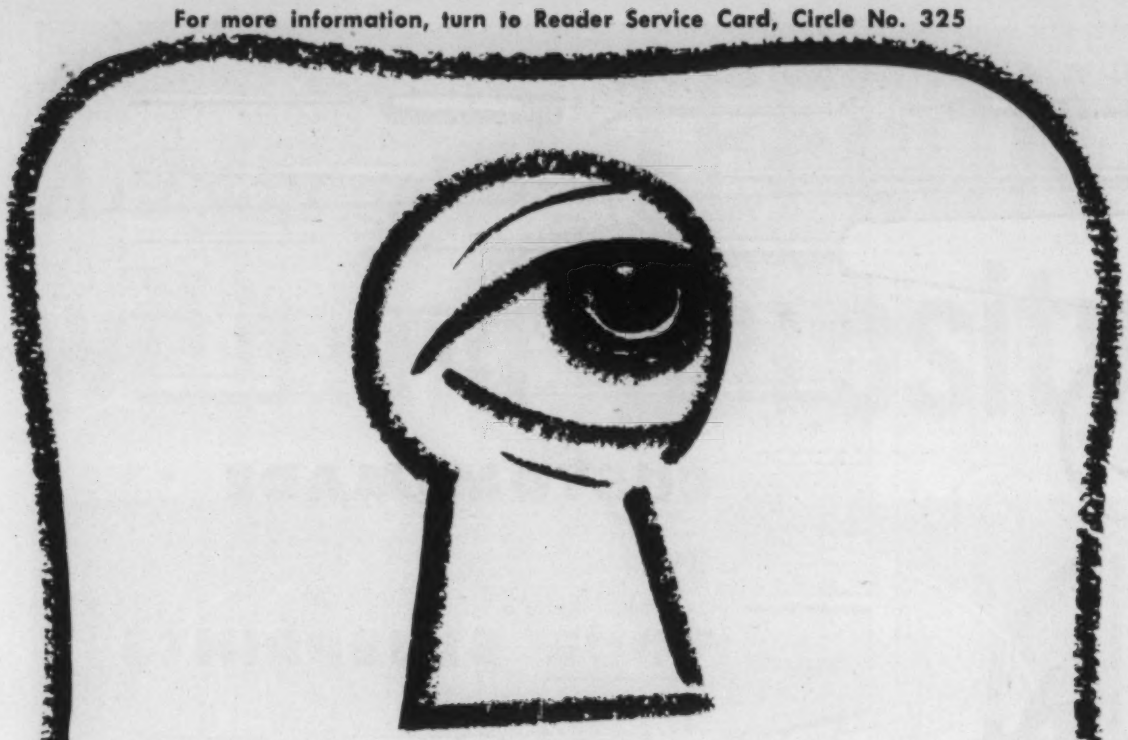
For more information, turn to Reader Service Card, Circle No. 325



YOUR COMPETITOR'S EYE will be quick to see profitable new plastics applications at the National PLASTICS EXPOSITION. New materials, new uses, new equipment—to see and feel. All that's new in plastics at Cleveland, June 7-10. Special conferences, too. Don't *you* miss it. Write for tickets today. On your company letterhead, please. Sorry, not open to general public.

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All types and sizes of screws (slotted, Phillips, socket, hex head), bolts, nuts, washers, rivets, keys and pins

- Over 9000 items in stock means *immediate delivery* from one source
- New Garden City plant now operating at top *speed and quality*
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ALLMETAL
SCREW PRODUCTS COMPANY, INC.
GARDEN CITY NEW YORK

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news of ENGINEERS

son has been named supervisor of nonferrous metallurgy and **Verne Pulsifer** has been appointed head of the metallography laboratory, Metals Research Dept., Armour Research Foundation.

Martin Ettington has been appointed general manager of engineering, American Locomotive Co.

Dr. S. Leroy Brown, former chairman of the Physics Dept., University of Texas, has joined Statham Laboratories as director of research.

Lee C. Sassmanhausen has been named works manager, Mullins Manufacturing Corp.

Frank W. Miner, Jr. has been named assistant to the department manager and **Benedict F. Melucci** has been appointed technical director, Manufacturers Chemicals Dept., American Cyanamid Co.

Dean Edward L. Cochrane has been appointed vice president for industrial and governmental relations and **Professor C. Richard Soderberg** has been named Dean of the School of Engineering, Massachusetts Institute of Technology.

Walter C. Loeman has been named manager of the Tube and Hose Fittings Div. to succeed **L. C. Aldridge** who has resigned. **James F. Davis, Jr.,** was promoted to fill Mr. Loeman's former position as production manager of the Industrial Hydraulic Div.

C. G. Mikkelsen has been promoted to supervisor of design engineering, graphic products group, Minnesota Mining & Manufacturing Co.

Elmer H. Koll has been named technical director, Milwaukee paint factory, Pittsburgh Plate Glass Co. **Arthur F. Rylander** will succeed Mr. Koll as assistant technical director.

Walter J. Assel, chief engineer, Steel and Tube Div., the Timken Roller Bearing Co., will retire from the company.

Arthur A. Conrad, Jr., metallurgist, has joined the Detroit Technical Section, Development and Research Div., International Nickel Co., Inc.

William D. Gross, works manager, Spaulding Works, Crucible Steel Co. of America, has retired after 41

You can simplify purchasing . . . improve design . . . speed production with improved C-D-F DILECTO® laminates

Only C-D-F, the Continental-Diamond Fibre Company, makes Dilecto laminated plastic, just as only Cadillac makes a Cadillac. Dilecto is 50 different materials with more combinations and variations in desired properties than we can tell you here.

But Dilecto has three important qualities that you should think about if you buy, design, or machine laminated plastics.

DILECTO HAS HIGH MECHANICAL STRENGTH

Mechanical strength is frequently an important determining factor in the selection of an insulating material. Insulating parts used in large electrical power equipment are frequently bulky. The high mechanical strength of Dilecto helps reduce size-dimensions of insulating parts without danger of failure. Instruments, meters and small motors frequently require very small insulating parts which must withstand comparatively large mechanical stresses. Insulation for use in high frequency circuits should have a minimum bulk factor for minimum dielectric losses. Dilecto fulfills these requirements with a combination of high mechanical strength and low loss factor, characteristic of the better C-D-F electrical grades.

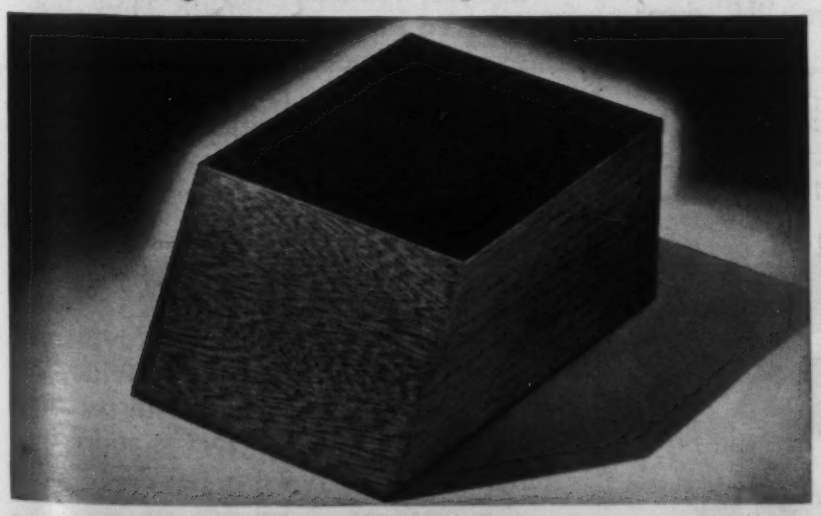
So C-D-F selects for your Dilecto insulation grade the correct, highest quality base material, paper, cotton, nylon, glass. These are used in combination with improved penetrating resins: Improved Phenolic, New Melamine, New Silicone, New Teflon, all synthetic, well polymerized resins.

Both the base and the resin are good insulators by themselves. But C-D-F sells them to you in an improved, practical form . . . Dilecto. Uniform sheets, tight tubes, strong rods, close tolerance machined and formed specialties, high bond strength metal clads.

Why does Dilecto combine so well mechanical strength with dielectric strength and dimensional stability? Because Dilecto is almost homogeneous, a true blend of resin and base.

DILECTO IS ALMOST HOMOGENEOUS

A poor laminate absorbs moisture at its edges, loses its insulating properties fast. Entrapped moisture and other volatiles within the cured structure causes inconsistent dielectric strength, with ultimate puncture and breakdown.



Punch press and bench saw operators know how much time and material is saved when the laminated plastic is *uniform* and *homogeneous* in nature like Dilecto.

DILECTO IS IMPROVED

Yes, C-D-F Dilecto is an improved laminated plastic, due to high standards and advances in resin and manufacturing techniques. It is watched by skilled workers in our modern plants, checked against rigid standards . . . C-D-F standards . . . by our quality control people. It is easy to machine, and the C-D-F shops are doing a booming business in specialties.

Table I—Typical Improved Phenolic Laminates

Commercial designation[a]	Resin	Filler	Improved properties	Improvement due to:
MEC-5	Phenolic	Nylon fabric	Insulation resistance; moisture resistance	Filler
XXHV-2[b]	Phenolic	Paper	High dielectric strength parallel to laminations	Resin and manufacturing technique
CRD	Phenolic	Cotton mat	Better machining	Filler
XXXP-26[b]	Phenolic	Paper	Insulation resistance; moisture resistance	Resin and manufacturing technique
C-92	Xylenol[c]	Cotton fabric	Alkali resistance	Resin
CF	Modified phenolic	Cotton fabric	Postforming	Resin

[a] All grades are Continental-Diamond Fibre Company.
[b] Resins have improved penetrating properties and the manufacturing techniques use these properties to provide better impregnation of the filler. Since thorough impregnation eliminates entrapped moisture and air, greater moisture resistance and better dielectric properties are attained. Manufacturing techniques also provide suitable temperature control during the curing stage to assure uniform quality and optimum property values in the finished laminate.
[c] Xylenol is essentially a dimethyl phenol.

—from Electrical Manufacturing Article "Wider Design Opportunities with the NEW Phenolics", Part II.

The next time you think of laminated plastics, the name to remember is C-D-F Dilecto. The improved, high strength, uniform material that makes insulation buying and using more a science, less a puzzle. New grades, new applications, new savings are just part of the Dilecto success story. Look up the facts in Sweet's Design File, or write for catalog. Send us your blueprint for quotation . . . tell us your design dream . . . C-D-F wants to work with you.

CDF Continental-Diamond Fibre

CONTINENTAL-DIAMOND FIBRE COMPANY
NEWARK 25, DELAWARE

For more information, turn to Reader Service Card, Circle No. 542

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Houghton

first for
design-engineered
PACKINGS

When you put your hydraulic or pneumatic packing problems into the hands of the Houghton Man, you can expect sound and unbiased recommendations. *Sound* . . . because we have made it our business to solve such problems in the past 30 years. *Unbiased* . . . because we make *all* types of packings, and we are free to recommend the one we know is *best* for your equipment. Like these . . .

- VIM LEATHER—Wax-impregnated; in Cups, "U's", "V's" and Flange types.
- RUBBER-IMPREGNATED VIM LEATHER; with leather's strength and rubber's flexibility.
- VIX-SYN—Synthetic rubber; in "O"-rings, "U"-cups and "V's".

Consult the Houghton Man or write E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Bulletins sent on request.

VIM and VIX-SYN PACKINGS
. . . products of

E. F. HOUGHTON & CO.
PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

For more information, turn to Reader Service Card, Circle No. 457

news of | ENGINEERS

years with the company. **Paul A. Karns,** recently associated with John A. Roebling's Sons Corp., succeeds Mr. Gross.

William T. Thomas, formerly with General Electric Co., has joined the staff of Ajax Electrothermic Corp. as assistant chief engineer.

Louis J. Baudis has been elected vice president in charge of manufacturing and director of the Bullard Co.

C. Harold Anderson has been appointed chief engineer, the Bullard Co.

news of | COMPANIES

Martin-Ruegg Brass and **Aluminum Foundry** has announced construction of a new die casting plant for its Die Casting Div. The plant will be located in Gardena, Calif.

Olin Industries, Inc. will erect a new cellophane plant in Kern, Warren County, Ind. It is estimated that the new plant will double the productive capacity of Olin cellophane.

Standard Pressed Steel Co. has completed a $10,000,000 phase of a continuing program of expansion and modernization under which the firm has doubled its space.

The **Richardson Co.** has announced a change of address to 27th Ave. and Lake St. Melrose Park, Ill. This change also includes the Lockland Office of the Richardson Co. of California.

Carbidie Inc., 27 Hillview Ave., Latrobe, Penna., has been newly founded to supply preformed carbide sections. The company is owner-operated by R. J. Steele, Logan J. Harr and E. J. Reitler whose combined talents cover more than 50 years in the carbide industry

Bakelite Co., a division of **Union Carbide and Carbon Corp.,** has announced the completion of an agreement with **Devoe & Raynolds Co., Inc.,** for licensing Bakelite to operate under the epoxy resin patents held or controlled by Devoe and Raynolds.

Royal Glass Works Corp. has changed its corporate name to Royal Glass & Millwork Corp. The new

name more accurately describes present operations.

C. I. Hayes Inc. has begun construction of a new plant at Cranston, R. I., near the location where the firm has been making industrial electric heat treating furnaces since 1905. Completion is expected shortly after mid-year.

Federal Latex Corp.'s expansion program is expected to be completed by late spring of this year. Installation of new compounding and storage tanks will more than triple present production capacity. Plans are already being made for corresponding increases in quality control and research facilities.

Compressed Air Products will now be known as The Airoyal Co.

Stillman Rubber Co. formally opened a Cleveland Division to assure speedy delivery of custom molded parts and to provide on-the-spot engineering services to the company's mid-western and eastern customers.

Hewitt-Robins Inc. has announced plans to acquire the business, plant and assets of **Fremont Rubber Co.,** producer of foam rubber and other non-tire rubber products.

Rolle Manufacturing Co. has announced expansion of its permanent mold facilities.

Detroit Stamping Co. recently completed the latest of its plant expansions which since 1940 have nearly tripled its original facilities.

Crucible Steel Co. of America and **National Research Corp.** have joined forces to accelerate development of the vacuum melting of steels and other alloys. Crucible has acquired a 50 percent interest in **Vacuum Metals Corp.,** formerly a wholly-owned subsidiary of National Research. According to a joint announcement arrangements have been completed for construction of a new vacuum melting facilities to be located in Syracuse, N. Y. in an expansion program that is expected to increase Vacuum Metals' capacity by more than 500 percent in the next twelve months.

Hughes Aircraft Co. is now a new corporation formed to carry on a portion of the activities previously conducted by the Hughes Tool Co. dba, Hughes Aircraft Co.

(Continued on page 290)

consult
Houghton

first for
precision-molded
RUBBER PARTS

You will be sure to get the sound and practical help you want when you talk to the Houghton Man about your molded rubber applications.

- He can give you—or get for you from our engineers—the experienced design and production aid that can only be offered after working closely with equipment manufacturers over the years.
- To get precision-molded parts with smooth, clean surfaces—sharp, accurate dimensions—made with proper rubber compounds carefully controlled—call in the Houghton Man.
- Or write directly to E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa., for prompt consideration of your precision molding problems.

PRECISION-MOLDED RUBBER PARTS
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PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

For more information, turn to Reader Service Card, Circle No. 456

where Quality counts

in a HEAT RESISTANT FINISH

High Temperature Electric Furnace made by Hevi Duty, Milwaukee, for heat treating high speed steel. Has inside temperatures of 2600°F. Finished in SICON green L6x642.

"DRESS UP" Your Laboratory in COLOR!

. . . with Sicon Silicone Coating

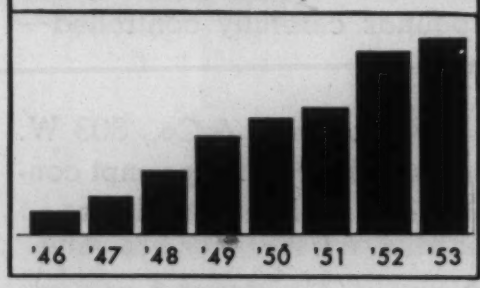
Note how an ordinary heat resistant finish starts to peel and crack a short while after application to heat-producing equipment.

HEVI DUTY uses SICON for protection against heat *and* to give greater color appeal

SICON not only provides better protection for products of the Hevi Duty Electric Company, but adds *color* appeal, a combination never available before in a heat resistant finish until the advent of silicone resins.

SICON, the original silicone-base heat resistant finish, is now available in various colors. No longer is it necessary to use drab paints and coatings where heat is involved. With SICON, a whole new area of longer product life and decorative finishing is available to the design engineer. For "longer life" and greater "sales appeal" decide now to "SICON-IZE" your products.

Chart below shows 8 year growth of SICON, and reflects how widely it is serving American Industry.



MIDLAND *Industrial Finishes Co.*
Waukegan, Illinois
ENAMELS · SYNTHETICS
LACQUERS · VARNISHES

Write Today for Case Examples of Other SICON Applications on Industrial and Consumer Products.

Name_____ Title_____

Firm_____

Street Address_____

City and State_____

For more information, turn to Reader Service Card, Circle No. 496

news of | COMPANIES

Investment Casting Co. has announced new modern facilities at 60 Brown Ave., Springfield, N. J.

General Electric Co. plans to build a new multi-million dollar plant in Roanoke County, Va. for industrial control equipment. The transfer of the department from Schenectady to the new 100-acre site will release facilities for scheduled expansion of other departments.

Pittsburgh Plate Glass Co. has purchased the property of the **Porcelier Manufacturing Co.** in South Greensburg, Penna.

Union Carbide scholarships to become effective in the fall of 1954 will bring the number of scholarships presently allocated to a total of 308 of a proposed goal of 400 scholarships. Ten more educational institutions recently have been added to the program bringing the total now participating to 34 liberal arts colleges and technical institutions.

Stronghold Pacific Corp. has announced change of its name to the Olympic Screw & Rivet Corp.

news of | SOCIETIES

Eta Kappa Nu, national electric engineering society, recently inducted Henry F. Dever, president, Brown Instruments Div., Minneapolis-Honeywell Regulator Co. and Richard P. Brown, former board chairman, now retired, into the society.

The **Pressed Metal Institute** has announced the appointment of Harold A. Daschner as assistant manager of the Institute.

The **Industrial Management Society** has announced that it is now accepting entries for its Fourth Annual Methods Improvement Contest to be held in conjunction with its 18th National Time and Motion Study and Management Clinic, November 10-12, 1954 in Chicago.

The **National Association of Corrosion Engineers** has announced that Edgar H. Dix, Jr., assistant director of research, Aluminum Co. of America, has received the Frank Newman Speller Award in recognition of his achievement in corrosion engineering.

(Continued on page 294)

FIND OUT ABOUT

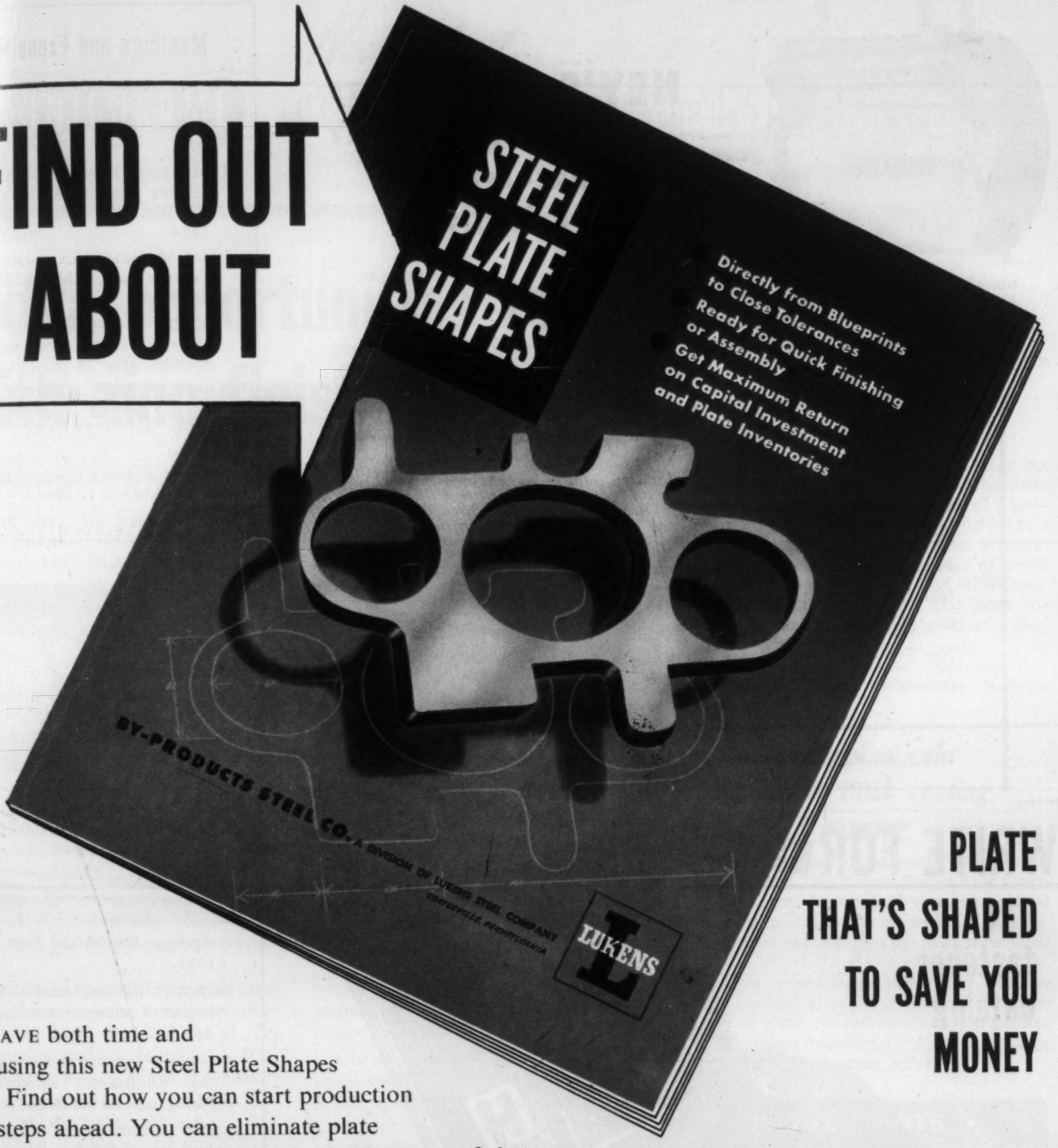


PLATE THAT'S SHAPED TO SAVE YOU MONEY

YOU SAVE both time and money using this new Steel Plate Shapes Service. Find out how you can start production several steps ahead. You can eliminate plate inventories, and you pay freight only on that part of the plate that is actually required.

There's no need to invest in new cutting and forming equipment for your own shops. We have over 150 major machines to flame-cut, shear, blank, press, bend or otherwise form steel plate.

This new Bulletin 712 shows how Steel Plate Shapes Service can help you. For a free copy, use this coupon or write on your company letterhead.

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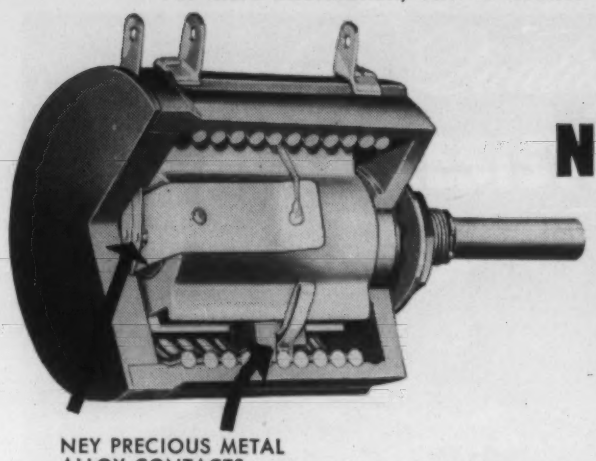
For more information, turn to Reader Service Card, Circle No. 483

For more information, turn to Reader Service Card, Circle No. 349



NEY PRECIOUS METAL ALLOY CONTACTS

NEY'S SMALL PARTS PLAY A BIG PART IN PRECISION INSTRUMENTS

The output of any potentiometer is dependent upon the contacts. Illustrated above is a Helipot 10-turn Potentiometer (Model A) using Ney Precious Metal Contacts between the slider and the resistance winding and for the slip ring pick-off, assuring the utmost in linearity and electrical transmission.

The J. M. Ney Company has developed a number of precious Metal Alloys and fabricates these into contacts, wipers, brushes, slip rings, commutator segments and similar components for use in electrical instruments. Ney Precious Metal Alloys have just about ideal physical and electrical properties, high resistance to tarnish, and are unaffected by corrosive atmospheres. Consult the Ney Engineering Department for assistance in selecting the right Ney Precious Metal Alloy which will improve the electrical characteristics, prolong the life and accuracy of your instrument.

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Specialists in Precious Metal Metallurgy Since 1812

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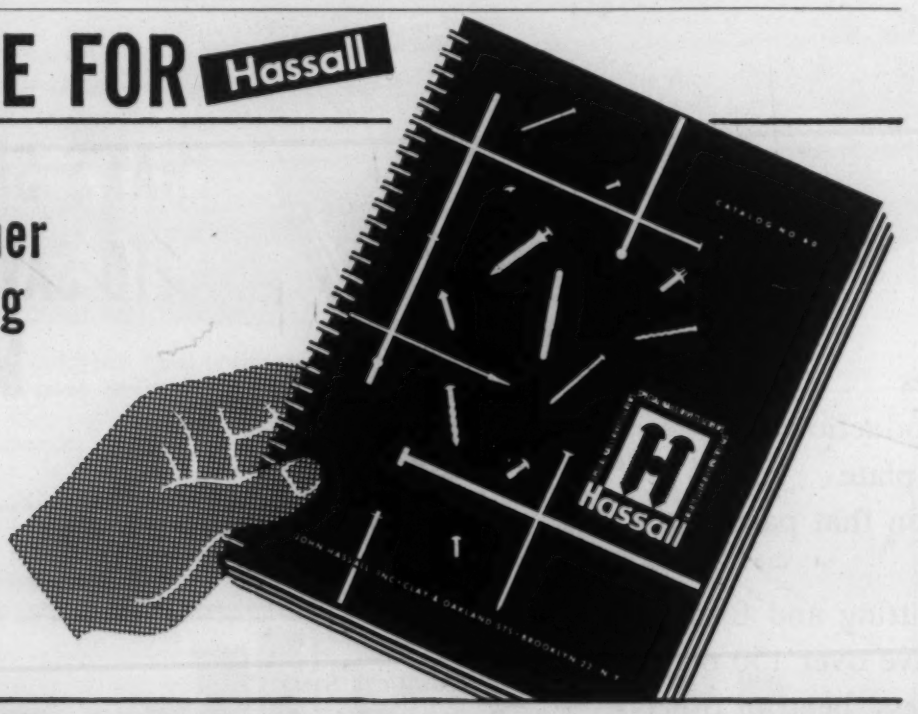

A complete, comprehensive handbook on cold-headed nails, rivets, screws and other special fasteners. Check on ways to improve your assembly cost-wise, appearance-wise and from a standpoint of maximum effectiveness at minimum cost. One hundred years of experience are at your service. Write for price quotations or for suggestions on the redesigning of your present assembly.

JOHN HASSALL, INC. P. O. BOX 2174 WESTBURY, L.I., N.Y.

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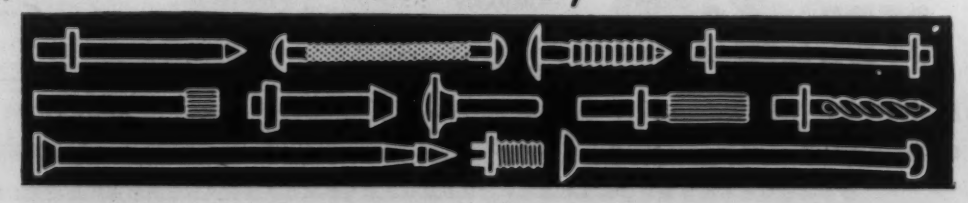

For more information, turn to Reader Service Card, Circle No. 355

Meetings and Expositions

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting. Springfield, Mass. May 16-19, 1954.

INDUSTRIAL FURNACE MANUFACTURERS ASSOCIATION, spring meeting. Hot Springs. May 16-19, 1954.

BASIC MATERIALS EXPOSITION AND CONFERENCE. Chicago. May 17-20, 1954.

COPPER & BRASS RESEARCH ASSOCIATION, annual meeting. Hot Springs. May 23-26, 1954.

AMERICAN IRON & STEEL INSTITUTE, general meeting. New York. May 26-27, 1954.

SOCIETY OF AUTOMOTIVE ENGINEERS, summer meeting. Atlantic City. June 6-11, 1954.

THE SOCIETY OF THE PLASTICS INDUSTRY, INC., national plastics exposition. Cleveland. June 7-10, 1954.

AMERICAN SOCIETY FOR QUALITY CONTROL, national convention. St. Louis. June 9-11, 1954.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting. Chicago. June 13-18, 1954.

MALLEABLE FOUNDERS' SOCIETY, annual meeting. Quebec, Canada. June 14-15, 1954.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, national congress of applied mechanics. Ann Arbor. June 14-18, 1954.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, semi-annual meeting. Pittsburgh. June 20-24, 1954.

INSTITUTE OF THE AERONAUTICAL SCIENCES, summer meeting. Los Angeles. June 21-24, 1954.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, summer and Pacific general meeting. Los Angeles. June 21-25, 1954.

ALLOY CASTING INSTITUTE, annual meeting. Hot Springs. June 27-29, 1954.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS, semi-annual meeting. Swampscott, Mass. June 28-30, 1954.

AMERICAN ELECTROPLATERS' SOCIETY, annual convention. New York. July 12-15, 1954.

SOCIETY OF AUTOMOTIVE ENGINEERS, West Coast meeting. Los Angeles. August 16-18, 1954.

WESTERN ELECTRONIC SHOW & CONVENTION. Los Angeles. August 25-27, 1954.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting. Milwaukee. Sept. 8-10, 1954.

UNICHROME
Trade Mark

News about
COATINGS for METALS
Metallic . . . . . Organic . . . . . Decorative . . . . . Protective

Extra opportunities to cut costs with zinc finishing

Wider choice of corrosion resisting chromate finishes being offered

Some of the many products finished in Unichrome Dips or Anozinc

CHROMATE treating still remains one of the best ways to finish zinc die castings or zinc plated steel. It strengthens corrosion resistance. It's an *easy* way to finish. It's economical. And time has proved its quality.

With such a combination of virtues offered in a finish, it pays designers, metal finishers and production men to review their products—and to evaluate the benefits of chromate finishing against their finishing requirements. Especially today—when the pressure is on to cut costs every possible way.

Through the unusually wide choice of finishes United Chromium provides, even greater benefits become possible. Here's why. A more economical dip solution may be chosen. Or a production advantage may be realized.

FOR EXAMPLE:

The right Unichrome Dip meant half the material consumption and longer solution life to one company.

Brighter finish on zinc plated hardware with less solution-waste was gained in another plant with still another compound.

Chromate treating of zinc plated steel shell cases done electrolytically with Anozinc is found best and cheapest in the long run by many producers.

HERE IS VARIETY

Unichrome chromate finishes offer a good color choice. Lustrous, clear bright finish or black—brassy yellow or olive drab—even brass-color—all these can be produced chemically by Unichrome Dip solutions.

Unichrome chromate finishes also satisfy production method requirements. Compounds are available for manual or automatic operation.

An exclusive electrolytic process, Anozinc* rounds out this complete line of conversion coatings. It's found especially economical in continuous, large run automatic production. This process permits finished parts to be handled while wet.

Write for more data.

**Trade Mark*

66% more chromium plating with same current source

One company, only able to plate *six* bumper bars per load, made a tremendous improvement by means of a simple change. They merely switched to a Unichrome SRHS Chromium Solution—and found that *ten* pieces of work per load could be covered with fewer rejections, all without any need for a larger current supply. That's good proof of the better coverage, higher efficiency and greater economy that "SRHS" offers. Write for Bulletin SRHS-2.

Sprayable plastisol builds up thick coating without sagging

First successful sprayable vinyl plastisols, the Unichrome Series 5300 Coatings can be applied even to vertical cold metal surfaces without sagging. Cured coating film up to 25 mils thick can be produced in a single application. Now even large areas can get the amazing protection against corrosion and wear offered by these non porous, chemical resisting, chip-proof coatings. Send for Bulletin VP-1.

HELPFUL HINTS
by "Mr. Cost Cutter"

For true economy in an organic finish, base your specifications on both quality and applied cost—rather than on misleading cost-per-gallon. Consider 3 flat black finishes for wrought iron, for example:

	applied cost/sq. ft.
Coating "A"	1.2 to 1.3¢
Coating "B"	0.8 to 0.9¢
Coating "C"	0.8 to 0.9¢

A Unichrome epoxy resin type finish, Coating "C" sells for twice as much per gallon as the other two, yet it not only gives best "mileage" but also a better looking, more durable and corrosion resistant finish.

UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y.
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For more information, turn to Reader Service Card, Circle No. 550

EXTRA!

Huck Manufacturing Company with their new additional factory and equipment announces new *availability of blind rivets and Huckbolts!*

9SP (Self Plugging) Rivets are *Now Available* in 95% of head styles, materials, diameters and grip lengths in nominal quantities *From Shelf Stock*. Extremely large quantities available to your order in two to eight weeks.

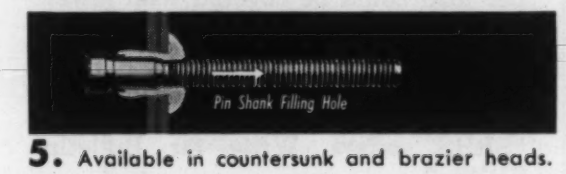
9SP BLIND RIVET FEATURES

1. ⅛" grip increment—more than twice that of any other self plugging blind rivet. Fewer lengths purchased in larger quantities means fewer sizes to stock and lower prices.

2. Counterbored sleeve tends to eliminate splits of blind heads on aluminum rivets.

3. Chamfered heads permit spin trimming.

4. Hole filling—pin expands sleeve to fill hole, eliminates joint deflection between materials.

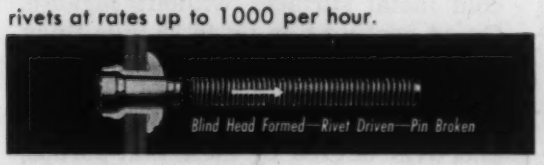


5. Available in countersunk and brazier heads.

6. Available in aluminum alloy or mild steel unichrome plated.

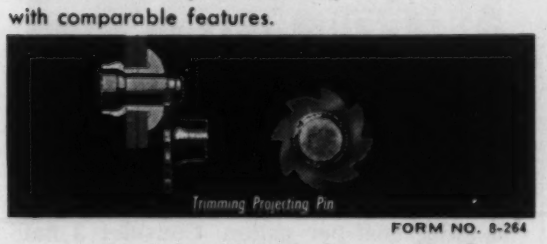
7. Materials are fastened together by one person from one side of work.

8. Hand and pneumatic tools install 9SP blind rivets at rates up to 1000 per hour.



9. Each rivet is automatically installed—eliminating human error.

10. Lower in price than any other blind rivet with comparable features.



FORM NO. 8-264

Approved by United States Air Force, United States Navy Bureau of Aeronautics, United States Navy Bureau of Ships, United States Armed Forces Ordnance Department, Civil Aeronautics Administration, and Underwriters' Laboratory.

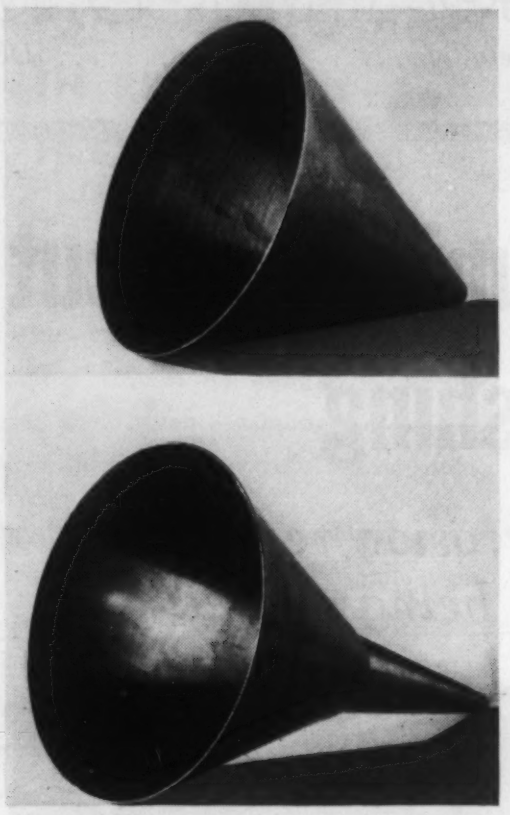
Let us know your fastening problems. Our specialized engineers will gladly make test installations, and figure installed costs without obligation on your part. When you think of fasteners, think of

Huck MANUFACTURING COMPANY
2480 BELLEVUE AVE., DETROIT 7, MICH.

News Digest

Flowturning . . .

continued from page 7

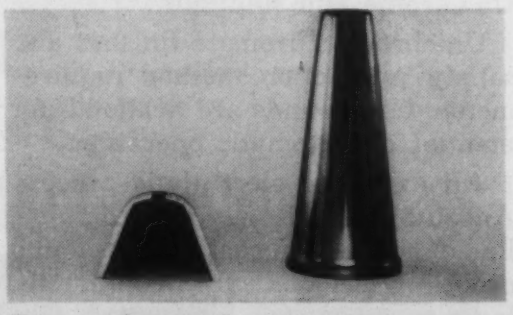


Double cone is produced in two operations from flat blank of stainless.

increased its tensile strength 100%. Even after stress relieving the increase amounted to 40%. Hardness increased from the annealed state to between 57 and 59 Rockwell 30-N.

The process will undoubtedly prove useful in short production runs where the expense of tooling up a series of deep drawing dies is not justified. A single mandrel will form a part in stainless steel that might require as many as ten progressive drawing operations. Producing such a part by machining, on the other hand, would cause a great loss of material. As an example of the savings possible through the use of the turning operation, company engineers showed how a part previously produced from a 369 lb forging which cost $276.75 was made from a 65 lb blank on the Floturn lathe. The material savings alone amounted to $228.00.

(More News on page 298)



Press formed cup, sectioned at left, was blank used in forming slow taper cone at right.

This small threaded stamping with an off-center hole is typical of parts on which the Mohawk method can save you money, too.

Mohawk stamps and taps in one operation, eliminating expensive jigs, fixtures, and secondary operations. And uniform threaded parts with squarely tapped holes assure further savings in smoother production.

As an example, one electrical component manufacturer found that it was costing him $3.52 per thousand for parts that Mohawk could deliver for $2.27. At a rate of 500,000 pieces per month Mohawk saved him $8700.00 per year.

Not only can Mohawk make the parts for less than it costs to manufacture them in your own plant, but there are no rejects —every part is usable.

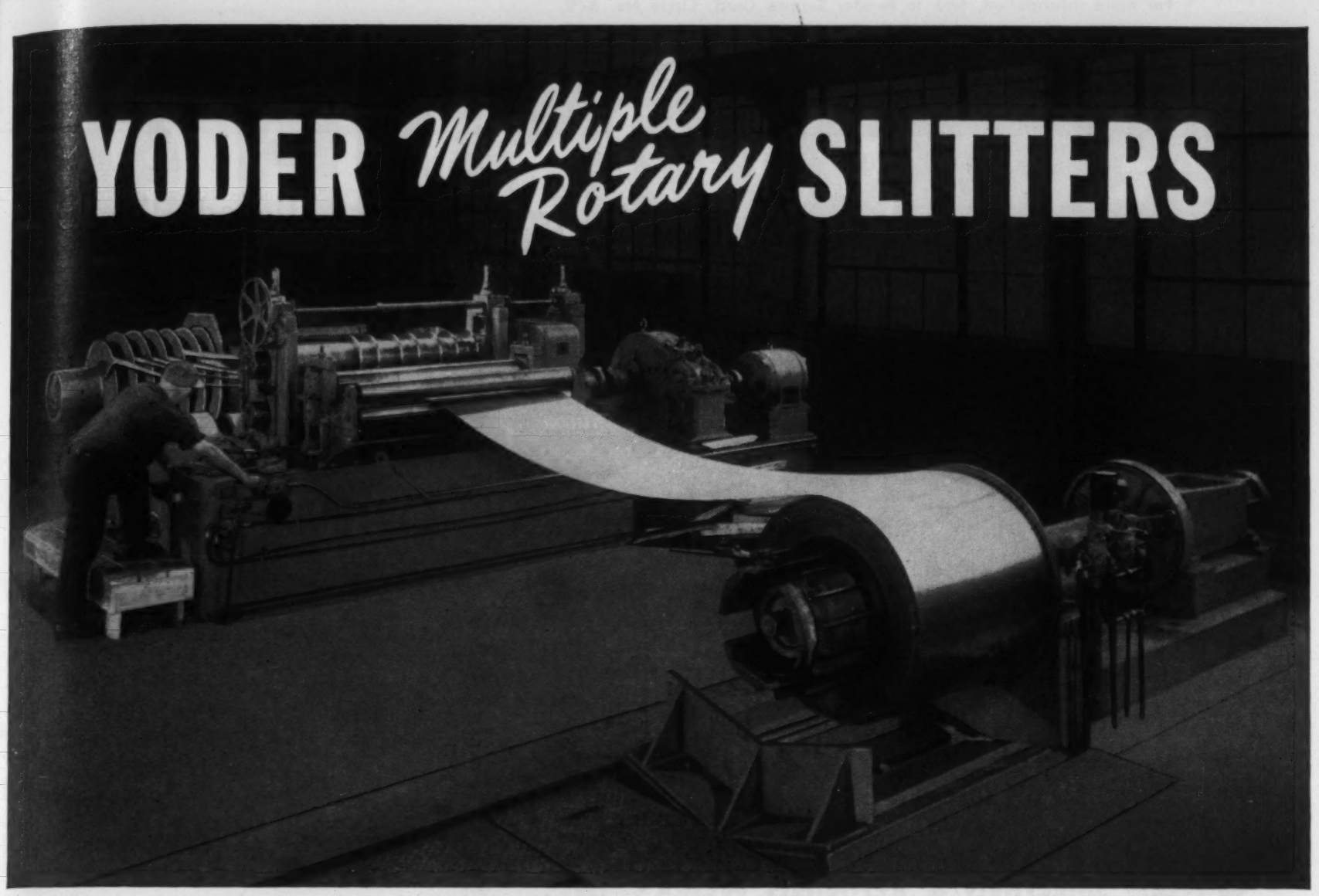
Specifications are held closely, right down to class 3 fit, and prompt delivery is assured even on intricate parts.

Add a press department to your factory and save time, money, and headaches.

Write or phone now.

mohawk
MANUFACTURING COMPANY
MIDDLETOWN, CONN.

YODER *Multiple Rotary* SLITTERS



pay Four Kinds of Dividends

If you use 100 tons or more of coiled strip or sheets per month, in special widths, the installation of a Yoder Slitter will pay four kinds of dividends:

1. Savings of $10 to $30 per ton by buying standard widths instead of slit strands. This saving alone often pays for the Slitter investment in a year or less.

2. You can buy standard widths competitively, wherever you can obtain the best quality, price and delivery.

3. Greatly reduced inventory requirements. From a relatively small stock of standard widths you can meet your own needs for special widths in a few hours.

4. Better control of production schedules since slitting service no longer is a problem.

Yoder slitters, uncoilers, recoilers and other accessories are made in many sizes and capacities, from the smallest to the largest. The Yoder Slitter Book is a treatise on the economics as well as mechanics of slitter operation—send for it.

THE YODER COMPANY • 5546 Walworth Ave., Cleveland 2, Ohio

Complete Production Lines

- ★ COLD-ROLL-FORMING and auxiliary machinery
- ★ GANG SLITTING LINES for Coils and Sheets
- ★ PIPE and TUBE MILLS–cold forming and welding

ENGINEERING YODER MANUFACTURING

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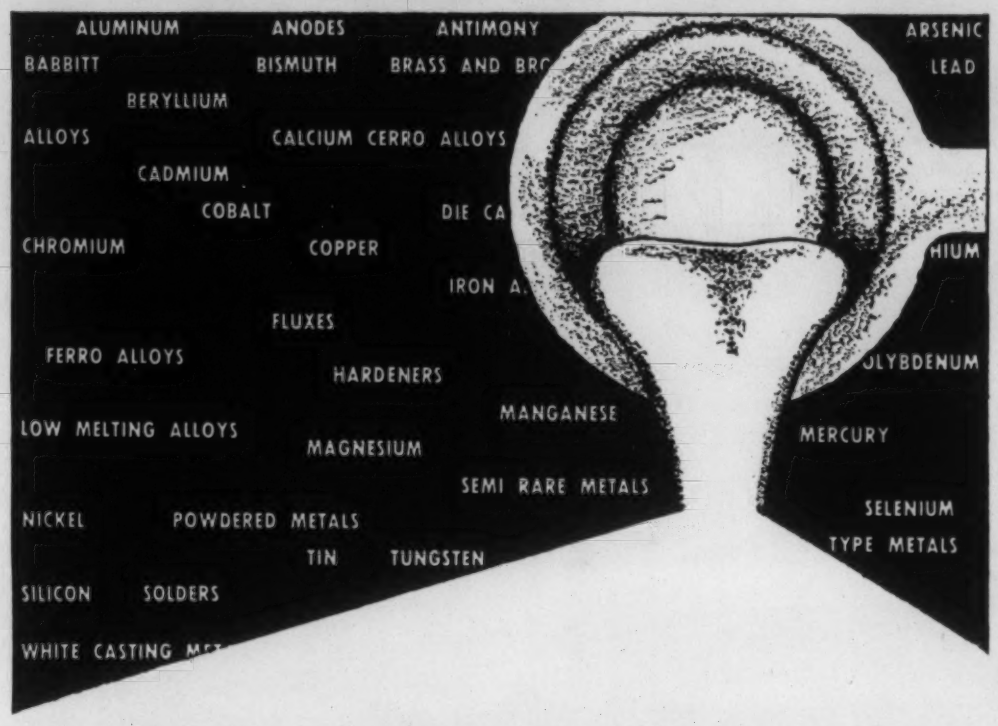
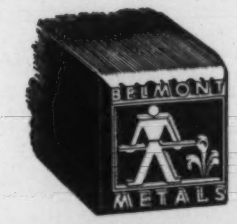
For more information, turn to Reader Service Card, Circle No. 370



all metals • all alloys • all forms

For the metals you need...
when and how you want them!



"Putting METTLE into METALS since 1896"

Belmont

SMELTING & REFINING WORKS, INC.

305 BELMONT AVENUE, BROOKLYN 7, N. Y. • DIckens 2-4900

Porcelain Laboratory Mill Jars

McDanel—*the original*—Metal Covered Grinding Jars never chip, crack or break. You use them and use them till they are worn out completely; and then, for a fraction of the cost, a new liner can be substituted for the old.

McDanel Jars are quality, long wear porcelain with heavy gage metal case. They are easy to handle, to clean, to discharge. They come in standard sizes and jar and cover surface are precision ground to fit to prevent leaks.

McDanel Jars are provided with rubber tires for roller machines. These tires are securely held in place by metal lugs spot welded to the case. McDanel offers the very latest and best in Grinding Jars—yet McDanel Metal Covered and All-Porcelain Grinding Jars cost no more.

Write today for "McDanel Industrial Porcelains" catalog

McDANEL REFRACTORY PORCELAIN CO.
BEAVER FALLS, PENNA.

GRINDING BALLS . . . MILL LINING BRICK . . .
MILL HEAD ASSEMBLIES . . . TANK & DRYER LININGS

For more information, turn to Reader Service Card, Circle No. 308

News Digest

Irradiated Plastic Now Available

Radiation Effects on Polymers Studied

Irradiated polyethylene, a material with superior heat and chemical resistance to normal polyethylene, is now available in experimental lots in narrow film form from the General Electric Company's Chemical Division.

Called "Irrathene", the plastic's improved properties result from cross linking or vulcanization of the polymer, resulting from bombardment with high energy cathode rays from million-volt electron generators. The irradiation gives the plastic form-stability at temperatures up to 300 or 350 F, and makes the material resistant to cracking when stressed and in contact with solvents and other active chemicals.

Sterilizable Packages

In the form of insulating tape and packaging film, irradiated polyethylene is expected to be a helpful factor in the development of smaller electrical equipment with improved operating characteristics, and in the creation of radically new heat resistant and sterilizable transparent containers for food, drugs, and other pharmaceutical products.

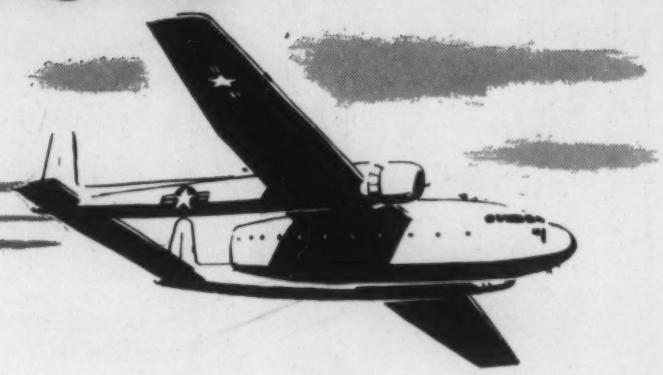
Large Volume Planned

G-E has concentrated an intensive development program on irradiated polyethylene. While present emphasis is on the film, other fabricated forms such as bottles, housewares and tubing are being investigated. Irradiated polyethylene will be available in pilot plant quantities later this year, and the company is planning to go into large volume production in the near future.

Irradiation of polyethylene is believed to be one of the first uses of electron irradiation in industry. The irradiated product is expected to expand both industrial and consumer applications of polyethylene plastics, which have been touted as the first billion pound plastic material.

Polyethylene probably will not be the only plastic to boast an irradiation treatment for long. J. W. Ryan, in a talk on the theory of physical changes in plastic caused by radia-

the FIRE TRUCK *that flies*

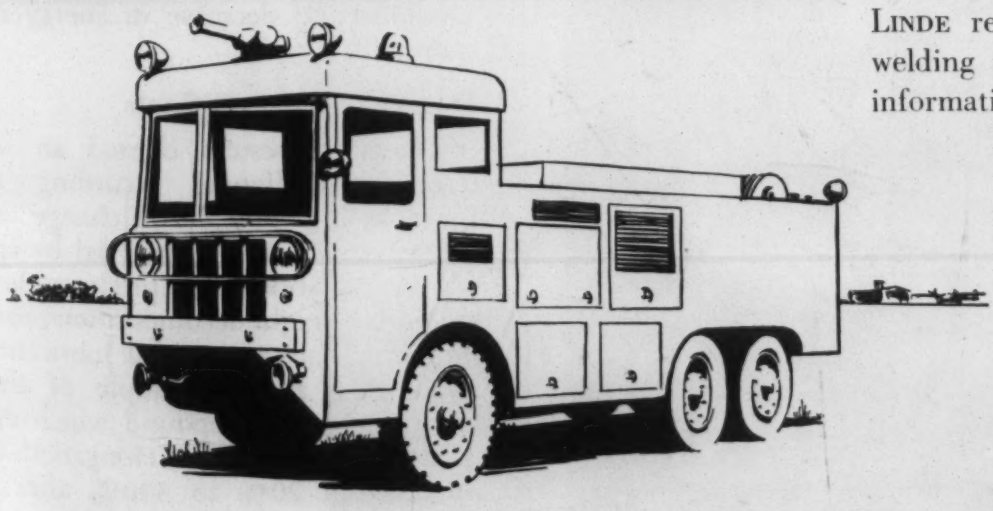


From rumbling horse drawn wagons, to the massive pump-trucks of today—weight has been the common characteristic of mobile fire-fighting equipment.

However, with the expanding science of fire-fighting, there came new demands of equipment. The United States Air Force had need for fire trucks fully equipped, yet light enough to be carried by air to landing strips the world over. Such trucks are now in production—fabricated by HELIARC and sigma welding.

The fire truck's rigid lightweight all-aluminum body, which varies in thickness from 14 ga. to ⅜ in., is completely welded by HELIARC and sigma welding at speeds up to 25 in. per minute. Because welding speed is high, and inert gas welding eliminates expensive post-weld cleaning, this manufacturer turns out three units a day—employing only 40 men.

Research and years of experience have helped LINDE to develop a top notch team of fabricating processes—HELIARC, sigma and UNIONMELT welding. For small shops or huge production lines, from carbon steel to complex alloys and non-ferrous metals—there is a LINDE electric welding process to do the job efficiently and economically. Your local LINDE representative will help you determine the best welding process for your job. Call him today for more information.



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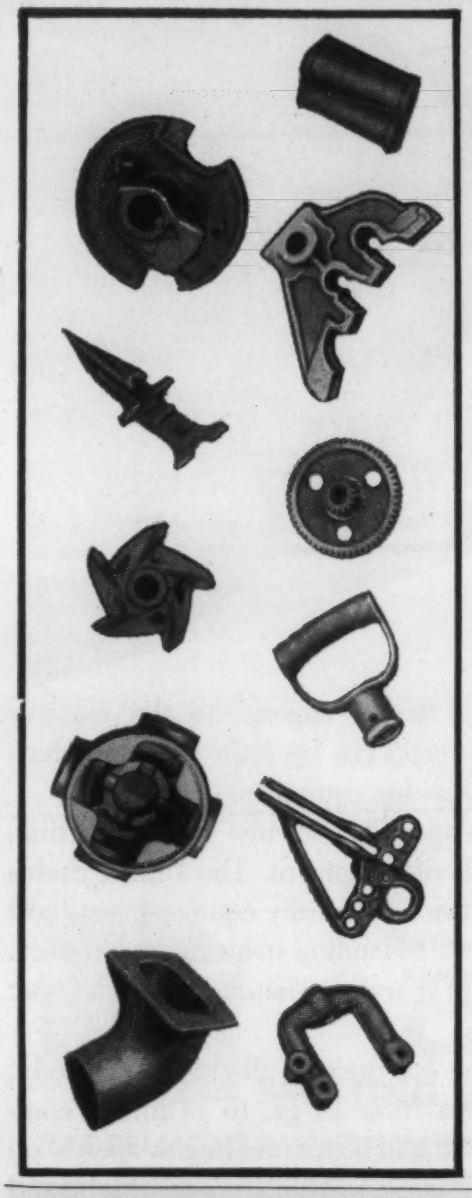

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Good service, quality control and reasonable prices are three reasons why your connection with Moline Iron Works can be both a pleasant and profitable one. We invite your specifications for quotation. We machine and finish, if desired.

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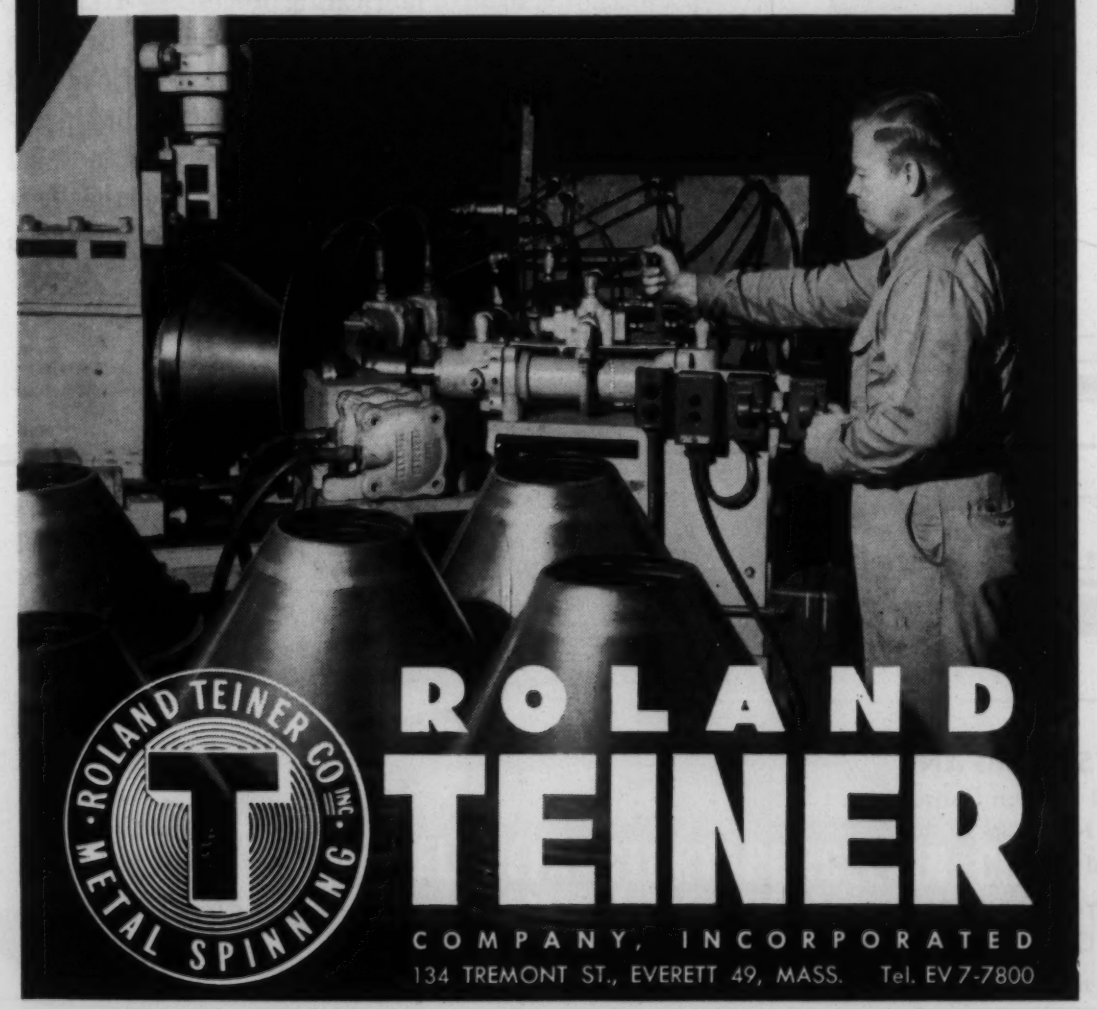
FILLING AN ORDER BY AUTOMATIC SPINNING. Automatic machines, developed by Teiner, permit precision spinning to reduce costs on long-run items. Example of the all-gauge — all-metal — any-quantity — spinning capacity available at Teiner. ***Write for color Brochure 52 M.***



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News Digest

tion at the recent Conference of the Society of Plastics Engineers, compared the effects of radiation on a number of different polymers. He feels that there is a "very substantial place in the field of plastics engineering for treating polymerizable materials with high energy radiation".

Effects Differ

Ryan discussed the effects of radiation on polyethylene, Teflon, linear polyesters, polystyrenes, and others. One invariable effect of radiation on all these materials is that they get harder and more brittle. Teflon is unique in that crosslinks do not form under radiation, and the material deteriorates quickly into a brittle, crumbly condition. X-ray diffraction studies indicate that a rapid increase in double bonds in the carbon and fluoride chains is the responsible factor.

Cross Links Formed

Polyethylene, the hydrogen analog of Teflon, forms good cross-linkages under radiation, and these cross-linkages are chiefly responsible for the changed and improved physical properties. Methylacrylates decompose under irradiation into gasses, and can be foamed under proper conditions of temperature and curing cycle. Polystyrenes are relatively stable under radiation, yet changes do occur, most probably in cross-linkages, an effect evident from the increase in elastic modulus and decrease in energy required to break.

Decomposition Effects

Linear polyesters offered an interesting challenge, according to Ryan, as it is possible to change the characteristics of the material by applying radiation that produces low molecular weight decomposition products which act as internal lubricants. Ryan gave as an example of this effect, an ester compound which exhibited an increase in elongation to break from 20% to 300% after a short exposure.

Concluding that radiation effects deserve extensive exploration, Ryan prophesied that future work in the field will result in materials for industry with much greater variation in properties than could be expected from standard techniques.

(More News on page 302)

Chance Vought F7U Cutlass

Here's a simple equation:

NO HIGH ALLOY STEEL = NO PLANE

Without stainless steel, super-high-temperature steels and special electrical alloys, it just wouldn't be possible to build, power and control a plane in the over-600-miles-per-hour class. That is our job: to develop and produce such metals . . . and if you have any problems that involve resisting corrosion, heat, wear and great stress, or require special magnetic properties, we're the people to see. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

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Warehouse stocks of A-L Stainless carried by all Ryerson plants

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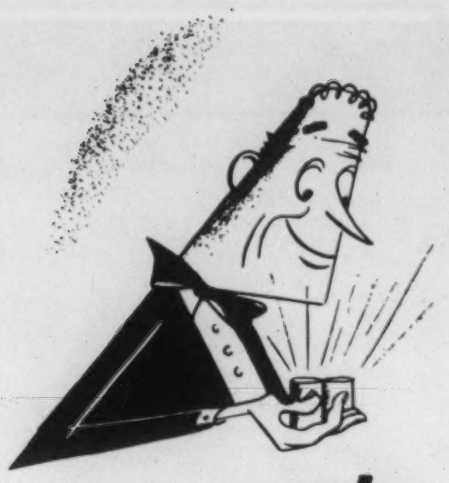

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Let us prove to you that LORCO Barrel Finishing Compounds will increase metal finish, color, and luster, and reduce your operational time cycles and costs.

Send us some samples of one of your hard-to-tumble parts . . . we will tumble them in the LORCO Compound designed specifically for the metal or alloy the part is made of . . . and the cleaning and finishing job required.

When you see the uniform, low micro-inch finish, and feel the ultra-smooth surface achieved by using LORCO Compounds employed in modern media, you'll see why so many barrel finishing operations today are using the new, highly efficient LORCO Barrel Finishing Compounds. You'll realize it's time you switched to LORCO Compounds. If you prefer, we will gladly send you samples of most LORCO Compounds, so that you can conduct the test yourself.

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BARREL FINISHING COMPOUNDS
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For more information, Circle No. 539

News Digest

Plastics Committee Meets in England

At the invitation of the British Standards Institution, this year's meeting of Technical Committee 61 (Plastics) of the International Standards Organization will take place in London during the week of October 4th.

ISO is an international body whose members are the standards organizations of the participating countries. The function of ISO is to foster international trade by providing uniform specifications and standards for such properties of materials of commerce as dimensions, tolerances and tests for quality.

This work is carried forward for plastics by Technical Committee 61, the American Standards Association serving as the secretariat of this committee for the delegations from the twelve member nations. The United States delegation to TC61, headed by Robert Burns of Bell Telephone Laboratories, consists of experts in various fields of plastics, selected to represent the recognized plastics groups in this country, namely, the Society for the Plastics Industry, the Plastics Committee of the Manufacturing Chemists Association, the Society of Plastics Engineers, and the Plastics Committee of the American Society for Testing Materials.

Transistors— Gossip's Nemesis?

A prime source of neighborhood intelligence—the rural party line telephone—may soon follow the pony express into oblivion, according to Bell Telephone Laboratories. Clandestine listeners-in on the local hookup in Americus, Georgia are soon to be foiled by a new telephone system utilizing transistorized oscillators which permit single wires to carry a number of conversations simultaneously without interference.

The method of transmitting a number of messages on a single conductor by means of a modulated carrier frequency has been in use for many years in long distance telephony and telegraphy, but until the advent

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For more information, Circle No. 557

Let adhesives like these speed your fastening jobs

Developing a new product? Pushing for faster production? If so, the right adhesive may be just the tool you need.

For example, the manufacturing operations shown here involve a wide variety of tricky bonding problems, all solved with Armstrong's Industrial Adhesives.

. . . A maker of radio speaker grilles has to bond a woven plastic fabric to plywood. Contact surfaces are very small but Armstrong's N-170 Adhesive does this hairline job with strength to spare.

. . . Paint rollers require an adhesive that resists the bond-breaking action of pressing and squeezing, as well as the attack of water and varied paint solvents. For this application, Armstrong's N-171 is the answer.

. . . Bonding vinyl—especially reverse-printed types—involves the risk of adhesive stains. Armstrong's non-staining N-111 or N-170 Adhesive solves this problem on chair backs and similar vinyl uses.

Many other exacting bonding applications are being handled every day by Armstrong's Adhesives. Perhaps you have a fastening problem you'd like to talk over. Call us or write for our new manual on Adhesives, Coatings and Sealers. Armstrong Cork Company, 8005 Dunbar Street, Lancaster, Pennsylvania. In Canada, 6967 Decarie Boulevard, Montreal.

ARMSTRONG'S

ADHESIVES • COATINGS • SEALERS

by the makers of Armstrong's Linoleum

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FEEL SMALL? Don't. Big ideas are awaiting you at the National PLASTICS EXPOSITION—Cleveland, June 7-10. Ideas that can help your business grow. New materials, new methods, new uses for plastics. Send for your admission tickets today. Please use company letterhead (sorry, no general public admissions).

NATIONAL PLASTICS EXPOSITION
sponsored by
THE SOCIETY OF THE PLASTICS INDUSTRY, 67 W. 44TH ST., NEW YORK, N. Y.

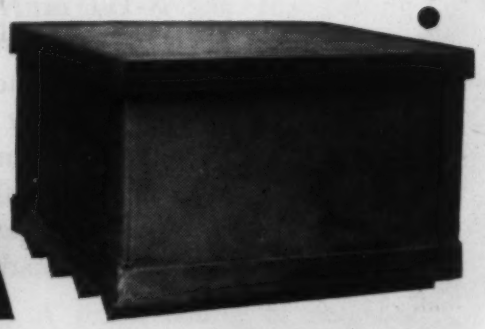
Stanwood CARBURIZING BOXES ARE BUILT FOR MAXIMUM SERVICE HOURS!

Snug Fitting Cover

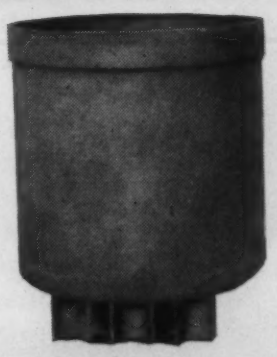
No Welds at Corners

Bottom has Reinforcing Flange

Easy-slide Skid Rails Strengthen Bottom



PLUS FEATURES throughout that insure maximum hours of service. Rolled plate sides cut weight, add room. Corners formed —not welded—all welds gas tight. Even expansion and contraction in all planes. High heat and corrosion resistance. Also square and round carburizing boxes. Stanwoods are Number 1 for service.



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News Digest

of the transistor, with its low power requirements, it was impractical on short distance, light load applications. In the new system, soon to be installed in a typical farming community in Georgia by the Southern Bell Telephone Co., the reduced size and power requirements of transistorized equipment enabled designers to work out an economical short distance network. The transistors require so little electric power that the batteries to supply them will be hung on the telephone poles with the oscillator-amplifier systems.

The transistorized rural equipment promises to bring much more efficient service to telephone subscribers—the lines will not be blocked by others using them, and single lines will accomodate many more telephones.

Bell reports that over 300 transistors are used in the experimental equipment which will be introduced to the Georgia community. Two lines, one 11½ miles long and one 15 miles long, extending from the central exchange in Americus, will try out the new system.

Equipment for the trial will be made in the Bell Labs and is designed primarily for experimental testing. The final designs for mass production will be much more compact, Bell advises.

(More News on page 306)

Listening for trouble. General Electric engineer listens through a solid steel rod as rotor of 125,000 watt generator is brought up to 3600 rpm for the first time. Any rubbing or bearing noise is easily detected through the steel stethoscope, one end of which is placed on the main bearing and the other end against bone behind engineer's ear.

Cut descaling costs of steel sheets, plates and coils to less than half!

Pangborn ROTOBLAST® Descaling Machine does thorough descaling job cheaply, eliminates scale breaking and pickling!

Whether you do your own pickling or have it done outside, the Pangborn Rotoblast Descaling Machine was designed for you! Ideal for descaling after hot rolling or certain heat treating operations, it gives a fine finish preparing surfaces for further operations.

Economy and convenience

Actual cases prove that Pangborn Rotoblast Descaling Machine operates for as low as $1.90 per ton compared with the much higher pickling cost. Unlike the acid bath, it can be located at a point convenient to your production and requires much less floor space than vats. In addition, it completely eliminates the acid disposal problem of pickling.

Versatility, dependability

The Pangborn Rotoblast Descaling Machine is available in a variety of models and descales steel sheets, plates and coils of any thickness and in any desired width and length. Rotoblast wheels descale the surface so thoroughly (both sides, if desired) that the smallest defects are quickly apparent, making inspection much easier. One man handles the entire operation by means of a push-button control panel at the feed end.

If you are interested

Why not see for yourself? If you like, send a representative and a batch of steel to our plant in Hagerstown. Watch this machine in action in our demonstration room, see how thoroughly it descales your product. Or call on your nearest Pangborn District Engineer to study the possibilities of this machine for your particular problem. No obligation in either case.
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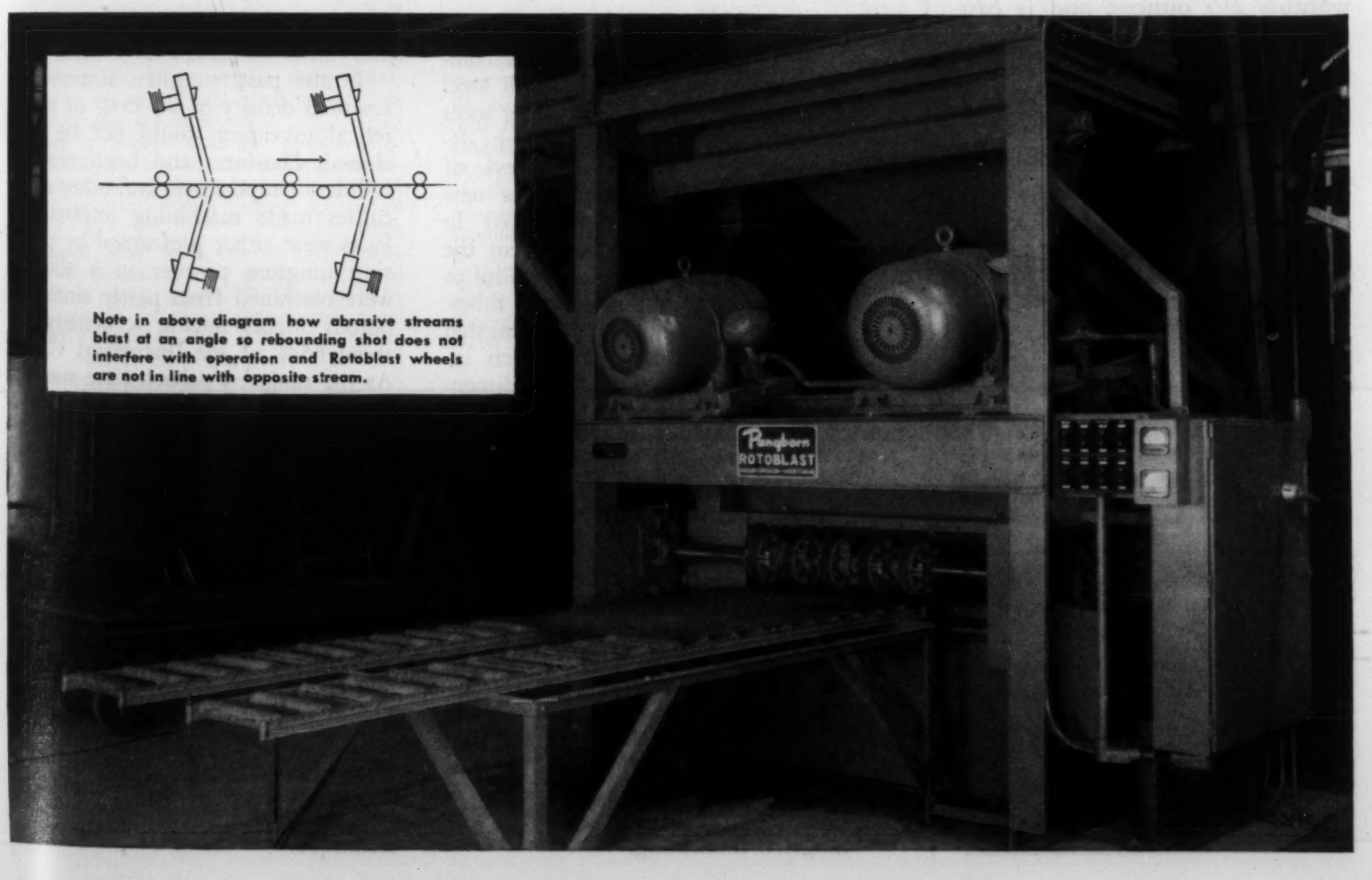
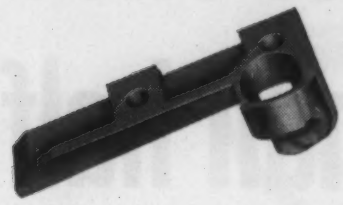
PANGBORN'S 50th ANNIVERSARY 1904-1954



Note in above diagram how abrasive streams blast at an angle so rebounding shot does not interfere with operation and Rotoblast wheels are not in line with opposite stream.

* For more information, turn to Reader Service Card, Circle No. 526

parts for new products



The part illustrated above is used in a new product recently put on the market by one of the leading portable power tool manufacturers. The piece is a complicated and difficult part to machine either from bar stock or from a forging as well as being very costly if made either way. The design had to be maintained in order to get proper performance of the machine.

After a few minor changes suggested by our engineers it was necessary for our customer to perform only a minimum number of finishing operations. They are putting the part into the unit at a substantial saving as compared to a fully machined part.

The piece is 3 inches long, weights 2½ ounces, and is cast in HYCC tool steel.

We would like the opportunity to look over some of your parts problems to see if we could be of assistance to you.

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Small precision castings of ferrous and non-ferrous alloys.

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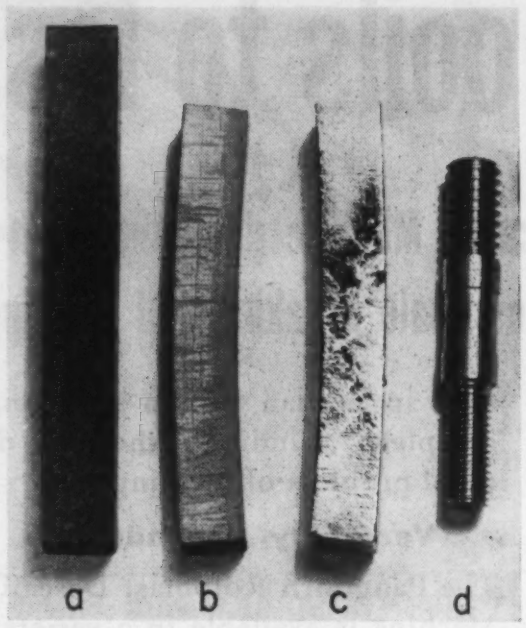
News Digest



Steps in machining tungsten part: a—Pressed ingot; b—Ingot after high temperature sintering; c—Copper impregnated ingot; d—Part machined from impregnated ingot.

Sintered, Infiltrated, Tungsten is Machined

A process for machining high density tungsten to tolerances comparable to those possible with steel or brass using ordinary cutting tools and shop equipment has been developed by Dr. Roberto Levi of Philips Laboratories, Inc. The new technique was first announced in December 1951, and at present the process is used for making Philips dispenser cathodes for electron tubes. It permits machining the tungsten cathodes to specifications which include accurately-controlled dimensions, porosity and gas permeability.

Impregnation is Key

Dr. Levi explained that the success of the new process depends upon three steps in handling the sintered tungsten ingots: 1) Impregnation with a suitable non-alloying wetting metal, such as gold or copper; 2) machining; 3) removing the impregnating metal. The impregnating metal acts as a filler and lubricant and prevents particles tearing out; and it eliminates burnishing and excessive tool wear which ordinarily occurs in tungsten machining.

Controlling factors of the physical characteristics of the sintered tungsten ingot are: sintering temperature for the tungsten powder, pressure used in forming the ingots and the dew point of the sintering atmosphere.

Counters Warpage

Sintering the tungsten ingot normally produces distortion and warping, but offers no particular problem if sintering precedes machining. The process temperatures at which the wetting metal is added and removed are well below sintering temperature and therefore have no effect on the final shape, tolerances, or physical characteristics of the machined piece.

High Density Parts

Tungsten parts having density values up to almost 90% of theoretical value may now be fabricated. Machining is relatively easy in the case of densities up to 83%. Higher density parts become more difficult to machine because the percentage of non-connecting pores, which cannot be infiltrated, goes up rapidly with increasing density.

Machineability

In the past, tungsten sintered to required density of 80-85% of theoretical maximum could not be machined. Hardness and brittleness at ordinary temperatures and other difficulties made machining impossible. Parts were either preformed by pressing tungsten powder in a die or were machined from partly sintered, porous ingots having a density of about 55% of the theoretical value. As the tungsten particles are weakly bonded together in partly sintered ingots, the particles were torn out in clusters instead of being cut by the cutting tool. Smooth surfaces could not be obtained, and shrinking and warping during the required final sintering operation made it difficult to maintain required shapes and dimensions.

The new Porphil process will permit drilling, grinding, turning, milling, threading and tapping of tungsten with ordinary machine tools. Dr. Levi expects new uses for tungsten to develop as a result of this improvement in tungsten forming technique.

Tool Steels. Firth Sterling Inc., No. 20-250 and No. 10-030, 2 pp each. Analysis, characteristics, applications, forging, heat treatment, annealing, hardening and tempering data for Firth Sterling BEST, carbon tool steel and FS 2-5 tungsten-vanadium-cobalt high-speed steel. (27)

Laminating Materials. Flexfirm Products. A folder with 7 technical bulletins. Nos. 1, 2, 3, 111, 112, 113, 105 and fabrication instructions for polyester resin impregnated glass cloth mat supplied in dry state ready for layup. (28)

Plywood. Hardwood Plywood Institute, 20 pp, ill. Physical properties of hardwood plywood; techniques for its use; and color reproductions of grain and grain structure. (29)

Electric Heating Elements. Holcroft & Co., 4 pp, ill. Describes four types of electric heating elements and their mounting methods. Classifies heat treat furnaces according to stock handling method. (30)

Copper Springs. Instrument Specialties Co., Inc., 16 pp, ill, No. 8. Custom-made beryllium-copper springs for use in electrical and mechanical applications. Suggests spring design techniques and lists physical properties of material. (31)

Cold Finished Steels. Jones & Laughlin Steel Corp., 14 pp, ill. Describes ten grades of free-machining open hearth steel with mechanical properties suitable for high quality machined parts. (32)

Leaded Steel. LaSalle Steel Co., 4 pp, ill. Lists available forms of free-machining, open-hearth, leaded-steel bar stock. (33)

Profilometer. Micrometrical Mfg. Co., 1 p, ill, No. LT-87. Describes a new profilometer-amplimeter and explains its functions. (34)

Tubing. A. B. Murray Co., Inc., Vol. 7, No. 2. Complete listing of stock of regular and extraordinary size stainless and mechanical tubing. (35)

Ceramic Specialties. Pemco Corp., 12 pp, ill. Porcelain enamel frits, glaze frits, coloring-oxides, glaze and vitrifiable glass colors. (36)

Zinc Coated Steel. Sharon Steel Corp., 12 pp, ill. Physical properties of hot-dipped, zinc-coated, strip steel. (37)

Rust Preventative. Stop-Rust Co., 8 pp, ill. Transparent soft film for corrosion prevention. (38)

Steel Strip. Weirton Steel Co., 20 pp, ill. Characteristics of electrolytic zinc-coated sheets and strip, high-tensile steel and high carbon strip cold-rolled spring steel which is being manufactured by the company. (39)

Other Available Literature

Irons and Steels • Parts • Forms

Precision Castings. Alloy Precision Castings Co., 8 pp, ill. Frozen mercury precision casting methods. Case histories of applications. (65)

Magnetic Materials. Arnold Engineering Co., 8 pp, ill. Tables, No. GC-106. Properties and applications of magnetic materials. Hysteresis loops, magnetization curves. (66)

Small Swaged Parts. The Bead Chain Mfg. Co. Describes Multi-Swage process for swaging small metal parts from flat stock. Shows advantages and applications of method. (67)

Stainless and Nickel Tubing. J. Bishop & Co. Platinum Works, 8 pp, ill. Stainless steel and nickel alloy tubing and small tubular specialties. (68)

Wire Cloth. The Cambridge Wire Cloth Co., 84 pp, ill. Illustrates the many different types of wire cloth, their typical applications and specifications. (69)

Precision Investment Castings. Cannon Muskegon Corp., 4 pp, ill. Gives the many advantages of using Master Met certified alloys in precision investment casting operations. (70)

Pre-Coated Metal Strip. Coated Coils Corp., 3 pp, ill. Versatile color finishes produced by an exclusive process is illustrated by actual sample of Enamellstrip, the metal coil pre-coated in color. Address inquiries to Mr. Marvin Richfield, Adv. Mgr., 513 W. 30 St., New York, N. Y.

Weldments. Continental Foundry & Machine Co., 6 pp, ill. Discusses fabricated steel weldments, composite welded assemblies of fabricated steel plate and castings, and cast welds assembled entirely of castings. (71)

Stainless Steel Tubing and Pipe. Damascus Tube Co., 8 pp, ill. Profusely illustrates the manufacturing process of stainless steel tubing and pipe offered by Damascus. (72)

Custom Steel Parts. H. Disston & Sons Inc., 16 pp, ill. Describes custom steel parts, how they are made and how to use and order them. (73)

Perforated Materials. The Harrington & King Perforating Co., No. 62. Catalog gives data on fabrication methods, how to order, types of perforation and uses of perforated materials. (74)

Metal Rings. King Fifth Wheel Co. Catalog and capacity charts of this company's facilities for bending and welding metal rings for industrial purposes. (75)

Pressed Parts. Lenape Hydraulic Pressing and Forging Co. Catalog shows numerous parts press formed by this company illustrating the kinds of jobs this firm can perform. (76)

Malleable Iron. Malleable Founders' Society, 12 pp, ill, No. 44. Useful information on machinability, structure, fatigue, endurance, notch fatigue endurance, impact resistance and other important attributes of malleable iron. (77)

Metal Powder Parts. Metal Powder Products, Inc., 4 pp, ill. Features a variety of applications for iron, iron-copper, and bronze sinterings produced by this company. (78)

Alloy Castings. Michiana Products Inc., 16 pp, ill. Description of facilities for producing alloy castings. (79)

Cold Extrusions. Mullins Mfg. Corp., 4 pp, ill, No. 2. Complete data on a variety of cold extruded hydraulic cylinders. (80)

Cold-Roll Formed Parts. National Metal Products Co., 4 pp, ill. Describes facilities of this company for producing cold-roll formed products. (81)

Seamless Steel Tubing. National Tube Div., U. S. Steel Co. Explains time- and cost-cutting fabricating applications of this company's Shelby seamless tubing. (82)

Tubing. Ohio Seamless Tube Div., Copperweld Steel Co., 8 pp, ill. Specifications and applications of a variety of Ostuco seamless and welded tubing. (83)

Expanded Metal Meshes. Penn Metal Co., Inc., 24 pp, ill, No. 493EM. Detailed information on Penmetal Expanded Metal, sheet metal that has been slit and expanded up to 10 times its original width. (84)

Metal Powders. Plastic Metals Div., 4 pp, ill, No. 567. Describes applications, advantages and limitations of powder metallurgy as used by this firm for custom making parts. (85)

Investment Castings. Precision Metalsmiths Inc. Entitled "Pour Yourself an Assembly," this booklet describes this company's facilities for casting in 160 different ferrous and nonferrous alloys. (86)

Alloy Steels. Republic Steel Corp., 16 pp, ill, No. ADV531. Contains seven case histories showing how customers increased production and cut costs through intelligent specifications of alloy steels. (87)

Wire Cloth. Reynolds Wire Co., 8 pp, ill, No. 1a/30a. Available materials, styles and sizes of industrial wire cloth, furnished in ferrous and nonferrous materials. (88)

Fabricated Alloys. Rolock Inc., 24 pp, ill, No. B-9. This corrosion resistant section profusely illustrates a large variety of baskets made with Rolock heat and corrosion resistant fabricated alloys. (89)

Stainless Steel Products. Schnitzer Alloy Products Co., 48 pp, ill, No. 50. Specifications and corrosion data on such stainless products as machine screws, nuts, pipe and tubing. (90)

Precision Castings. Sessions Foundry Co., 8 pp, ill. Presents design and engineering data on Hyprecision castings. (91)

Alloyed Gray Iron Castings. Superior Foundry Inc., 8 pp, ill. Gives advantages, specifications, and illustrates production methods of Superior's electric furnace process for producing alloyed gray iron castings. (92)

Cold Rolled Steel. Thomas Strip Div., Pittsburgh Steel Co., 50 pp. Complete table on pound for lineal foot in weight for cold rolled strip steel in widths of 1/4 in. to 24 in. and thicknesses from 0.001 to 0.2757. (93)

Stainless Tubing. Trent Tube Co. "Trentweld Data Bulletin" describes Trentweld stainless steel tubing, machine formed and welded in wide range of sizes. (94)

Fine Seamless Tubing. Uniform Tubes, 4 pp, ill. Covers a complete line of fine seamless tubing available in sizes from 0.10- to 5/8-in. O.D. and in metal of almost any desired analyses. (95)

Steel Castings. Unitcast Corp., ill, No. 649-A. Discusses this company's testing facilities for insuring high quality production of steel castings. (96)

Tool Steels. Universal-Cyclops Steel Corp., 8 pp, ill. Description, properties and applications of seven tool steels, designed for specific uses in machining and die work for the fastener industry. (97)

Stainless Steel Sheet and Strip. Washington Steel Corp., 4 pp. Includes types, uses, physical properties and specifications of MicroRold stainless steel sheet and strip. (98)

Nonferrous Metals • Parts • Forms

Bronze Bushings, Bearings, Etc. American Crucible Products Co., 12 pp, ill. Technical data on a variety of Promet bronze bushing, bearings, bar stock and babbitt

MANUFACTURERS' LITERATURE

metal available in a series of standard formulas. (101)

Precision Investment Castings. American Precision Casting Corp., 8 pp, ill. Shows the steps involved to obtain precision investment castings using the "lost wax" process. (102)

Beryllium-Copper Springs. Beryllium Corp., 6 pp. Lists advantages of using beryllium-copper as a spring material, and gives physical and mechanical properties. (103)

Magnesium. Brooks & Perkins, Inc., 8 pp, ill. Describes the facilities and services of this company for fabricating magnesium. (104)

Investment Castings. Casting Engineers, Inc., 4 pp, ill, No. 17. Discusses advantages of investment castings and characteristics of investment cast parts custom-made by this firm. (105)

Thermostatic Bimetal. W. M. Chace Co., 32 pp, ill. Lists 18 uses of thermostatic bimetal as the actuating element in temperature responsive devices, and gives condensed engineering data for bimetal element and design and selection. (106)

Metal Stampings. Dayton Rogers Mfg. Co., 4 pp, ill. Describes low cost process for producing metal stampings in small lots. Shows costs of several example jobs. (108)

High Density Metal. Fansteel Metallurgical Corp. Describes Fansteel 77 Metal, said to be strong, machinable, useful in rotors and balance weights, have a density close to that of tungsten. (109)

Magnesium Castings. General Magnesium Foundries, Inc., 4 pp, ill. Profusely illustrates the facilities of this company for producing magnesium castings. (110)

Copper-Clad Aluminum. General Plate Div., Metals & Controls Corp., 6 pp, No. 702C. Technical data on Alcuplate, a composite metal consisting of a layer of aluminum on which a thin layer of copper is clad on either or both sides. (111)

Zinc Die Castings. Gries Reproducer Corp., 4 pp, ill. Specifications of corrosion resistant nonferrous zinc alloy wing nuts, small zinc die castings and injection moldings. (112)

Copper and Brass Tubing. H & H Tube & Mfg. Co. Describes a complete line of seamless braze and lock seam copper and brass tubing. (113)

Aluminum Extrusions. Harvey Aluminum Div., Harvey Machine Co., 8 pp, ill. Properties, characteristics and applications of a variety of aluminum extrusions produced by this company. (114)

Precision Investment Castings. Hitchiner Mfg. Co., Inc., 6 pp, ill. Evaluates precision investment casting methods as to costs, production and properties of parts. (115)

Laminated Metals. Improved Seamless Wire Co., Inc., 6 pp, ill. Describes the importance and application of laminated metals to modern industry. (116)

Precision Cast Parts. The Jelrus Co., Inc. Advantages of centrifugal precision casting for custom manufacture of complex parts accurately and quickly. (117)

Silicon Bronze. R. Lavin & Sons Inc., 8 pp, ill, Vol. 9, No. 1. "The Lavingot" contains an interesting article on the subject of silicon bronze. (118)

Gaskets. Lead Alloy Products Co., 4 pp, ill. Lead clad copper seals combine ductility and strength. (119)

Die Castings. Madison-Kipp Corp., 32 pp, ill. Describes company's aluminum and zinc die castings. Also shows Kipp Featherweight air grinder and Fresh-Oil lubricators. (120)

Magnesium. Magline Inc., 8 pp, ill. Facilities for fabricating magnesium and producing sand castings. (121)

Tungsten Carbide Parts. Metal Carbides Corp., 68 pp, ill, No. 52-G. Description, specifications and prices of standard Talide Metal dies, rolls, bushings, forms and special shapes. (122)

Sintered Metal Bearings. Michigan Powdered Metal Products, Inc., 2 pp, ill. Describes sintered metal bearings with cavities in bearing walls to enable greater oil content and heavier bearing loads. (123)

Die Castings. Monarch Aluminum Mfg. Co. File data on aluminum and zinc die castings and aluminum mold castings showing applications, advantages and this company's facilities for making them. (124)

Forged Brass Parts. Mueller Brass Co., 5 pp, ill. Lower cost, better machinability are among advantages stated for forgings over sand castings used for hardware. (125)

Die Castings. Paramount Die Casting Co., 4 pp, ill. Facilities of this company for producing aluminum, magnesium and zinc die castings. (126)

Copper Tubing. Penn Brass & Copper Co., 6 pp, ill. Features of this company's seamless copper tubing. Includes tables of safe internal working pressures of various tubing sizes. (127)

Aluminum Castings. The Permold Co., ill. Shows how continuous, scientific control of Permold aluminum casting quality, to specifications, saves time and money. (128)

Spun Shapes. Phoenix Products Co., Metal Spinning Div., 4 pp, ill. Describes Phoenixspun methods for spinning spherical and extra deep-drawn contours. (129)

Extruded Aluminum. Precision Extrusions, 98 pp, ill. Lists over 4000 standard extruded aluminum shapes, rods, bars and tubing available without additional die service charge. (130)

Bushings. Randall Graphite Bearings, Inc., 12 pp, ill, No. 100. Complete price list of bronze bushings and specially grooved bushings; specifications of bored and solid bronze bars. (131)

Aluminum and Magnesium Sand Castings. South Gate Aluminum & Magnesium Co., 12 pp, ill. Features the facilities of this company for producing precision aluminum and magnesium sand castings and precision machined parts. (132)

Bourdon-Tube Materials. Superior Tube Co., 4 pp, ill. Reprint discusses properties, shaping, working and joining of three basic classifications of Bourdon-tube materials. (133)

Light Metal Castings. Light Metals Div. Thompson Products Inc., 8 pp, ill. Describes a complete line of precision die castings for various industrial uses. (134)

Flexible Tubing. U. S. Flexible Tubing Co., 16 pp, ill. Description, applications and specifications of this company's flexible metal tubings, bellows for control units, and other metal parts. (135)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on pages 317 and 318

Nonferrous Castings. The Wellman Bronze and Aluminum Co., 16 pp, ill, No. 50. Characteristics, typical uses and specifications of Well-Cast magnesium, aluminum and copper-base alloys. (136)

Screw Machine Products. Westfield Metal Products Co., Inc., 4 pp, ill. Describes facilities for the production of a variety of machines, nuts and screw machine products. (137)

Nonmetallic Materials • Parts • Forms

Rubber Parts. Acushnet Process Co., New Bedford, Mass. Illustrates variety of rubber parts company can make to order. Request on company letterhead direct from Acushnet.

Extruded Plastic. Conneaut Rubber and Plastics Co., 4 pp, ill, No. CR-53. Die making and production facilities of rubber and plastic extrusions. (139)

Polyethylene Resins. American Agile Corp., 8 pp. Comprehensive summary of physical and chemical properties of Agilene polyethylene resins fabricated by this company. (140)

Filter Mat. American Felt Co., 6 pp, ill. Technical data and sample of Dynel Windsor Felt, a new fiber-bonded filter mat for use in filter press or vacuum filter applications. (141)

Acrylic Rubbers. American Monomer Corp., 4 pp. Properties and recommended uses of Acrylon BA-12 and EA-5 acrylic rubbers. (142)

Plastic Pipe. Anesite Co., 2 pp, ill. Specifications and applications of Black-Buty plastic pipe, designed to combat corrosion and avoid parafin build-up in gathering lines and salt water disposal systems. (143)

Aluminum Adhesive. Armstrong Products Co., 6 pp, ill. Features the properties of adhesive for bonding aluminum at contact pressure. (144)

Fiber Glass Ducting. Arrowhead Rubber Co., 16 pp, ill, No. 503. Detailed engineering data on descriptions and applications of this company's Fiberglas flexible and rigid ducting. (145)

Rubber Parts. Automotive Rubber Co., Inc. Series of bulletins show use of rubber for insulation or corrosion prevention in industrial equipment. (146)

Balsa Wood. Balsa Ecuador Lumber Corp., ill. Brochure contains a number of sheets discussing various Kilndried Balsa lumber and Balsa products. (147)

Glass Fiber Sleeving. Bentley-Harris Mfg. Co., 4 pp. Describes new Fiberglas tubing and sleeving with high physical and dielectric properties. (148)

Ceramic Bodies. Centralab Div., Globe-Union Inc., 28 pp, ill, No. 720-10M. Comprehensive survey of this firm's ceramic production. Includes description of engineering properties of ceramics, design information, allowable tolerances, and indicates broad scope of ceramic products with data dimensions. (149)

Compounded Elastomers. Chicago Rawhide Mfg. Co., 32 pp, ill. Characteristics, properties and engineering applications of Sirvene compounded elastomers. (150)

Plastic Lined Fittings. The Dow Chemical Co., 32 pp, ill, No. SL6-N-250. Properties, design data and applications of Saran-lined steel and iron pipe fittings and valves. (151)

Glass Products. Dunbar Glass Corp., 4 pp, ill. Descriptions of this firm's various in-

dustrial glasses. Explains advantages of glass to the designer and gives physical properties. (152)

Viscose Rayon for Industrial Use. E. I. du Pont de Nemours & Co. (Inc.), Rayon Div., 9 pp, ill, No. A-319. Gives physical properties, performance and applications of "Cordura", a high tenacity viscose rayon fiber. (153)

Synthetic Elastic Compositions. E. I. du Pont de Nemours & Co. (Inc.), Fabrics Div., 8 pp, ill, No. A-3304. Features a detailed table of physical properties of Fairprene synthetic elastic compositions. (154)

Phenolic Molding Compounds and Resins. Durez Plastics & Chemicals, Inc., 4 pp, ill. Includes types, properties and uses of a variety of Durez phenolic molding compounds, industrial resins and coating resins. (155)

Metal and Plastics Parts. The Electric Auto-Lite Co., Bay Mfg. Div., 16 pp, ill. Shows wide variety of custom-made ornamental and functional metal and plastics parts. (156)

Custom Molded Plastics. Erie Resistor Corp., Plastics Div., 4 pp, ill. Illustrated tour through Erie's new Plastics Div. headquarters showing equipment for manufactured custom molded plastics. (157)

Coloring Acrylics. Ferro Corp., 2 pp. Advantages and method of using Ferro acrylic color for users of lucite and plexiglas. (158)

Flexible Tubing. Flexible Tubing Corp., 8 pp, ill, No. 5-4. Applications and performance data on Spiratube flexible tubing for ventilation and materials conveying. (159)

Cast Wood. Forestrong Co., 4 pp, ill. Profusely illustrates and describes a wood fiber molding process. (160)

Plastics Parts. Franklin Plastics Div. of Robinson Industries, Inc., 6 pp, ill. Illustrates variety of plastics products and discusses this company's injection molding facilities. (161)

Silicone Rubber. General Electric Co., Chemical Div., 24 pp, ill, No. CDS-3. Includes comprehensive information on properties, applications, classes and design applications of G-E silicone rubber. (162)

Rubber-Cushioned Parts. General Tire & Rubber Co., 12 pp, ill. Describes General Silentbloc method of mounting, coupling or isolating moving machinery on rubber. Shows standard parts and specifications. (163)

Polyvinyl Resins. B. F. Goodrich Chemical Co., 12 pp, ill. Case histories describe packing problems of typical users of Geon resin coatings and films and solutions provided by these materials. (164)

Self-Lubricating Bushings. Graphite Metallizing Corp., 8 pp, ill, No. 108. Describes Graphalloy grades for bushings and electrical uses. Bearing design data included. (165)

Polyvinyl Chloride. H. N. Hartwell & Son, Inc., 6 pp, ill, Nos. 2B and PF. Data sheet and basic information on Boltaron 6200, a nonplasticized polyvinyl chloride. (166)

Plastics. Heresite & Chemical Co., 24 pp, ill. Oil-free thermosetting phenolic coatings, thermosetting and thermoplastic resins, molding compounds, synthetic rubber coating sheets and molded forms. (167)

Molded Plywood. Keller Products Inc., 12 pp, ill. Booklet describes standard and constantly used die shapes for molding plywood as an aid to designers of molded plywood shapes. (168)

Glass. Kopp Glass Inc., 18 pp, ill. Methods by which Kopp glass products are designed and made to meet strict specifications for light transmission and distribution, physical properties, dimensional exactness and other requirements. (169)

Plastics. Koppers Co., Inc., Chemical Div., 4 pp, ill, No. C-2-135. Presents applications, advantages and typical properties of Koppers Polystyrenes and Koppers Modified Polystyrenes. (170)

Glass. Lancaster Lens Co., 8 pp, ill. Twenty-one case histories of a wide variety of glass part applications. (171)

Tempered Glass. Libbey-Owens-Ford Glass Co., 4 pp, ill. Physical properties of Tuf-Flex tempered plate glass for heat and impact resistance in industrial applications. (172)

Electrical Insulation. Louthan Mfg. Co., 13 pp, ill, No. 49-E. Uses and specifications of Louthan insulations in mechanical, electrical, thermal and electronic fields. (173)

Industrial Porcelains. McDaniel Refractory Porcelain Co., 24 pp, ill. Descriptions, outstanding features and specifications of various types of industrial porcelain parts. (174)

Glass Products. McKee Glass Co., 16 pp, ill, No. 12-68. Describes types of glasses manufactured, their applications and facilities for large-scale production. Illustrates numerous products for home and industry, including electrical, laboratory, television and marine equipment. (175)

Hardboards. Masonite Corp., 24 pp, ill, No. 1d/2. Properties and advantages of Preswood and other Masonite hardboards, and their relation to product design. (176)

Self Lubricating Bearings. Metallized Carbon Corp., 4 pp, ill. Includes typical mechanical and electrical applications of self-lubricating bearings made of metallized carbon-graphite. (177)

Electrical Insulating Material. Mica Insulator Co., 4 pp, ill. Complete data on Isomica, a new and improved electrical insulation with higher dielectric strength, greater uniformity and better physical characteristics. (178)

Corrosion Proof Tubing. Samuel Moore & Co., 4 pp, ill, No. L-6506. Shows ways to overcome corrosion and high tubing installation through the use of Dekoron instrument tubing. (179)

Nonmetallic Pipe. National Carbon Div., 16 pp, ill, No. CP-2212. Chemical resistance, properties and specifications of pipe and fittings of Karbate, phenolic impregnated carbon and graphite. (180)

Refractories. Norton Co., 24 pp, ill. Uses and characteristics of four major refractories supplied in grain shapes and cements. (181)

Rubber. Ohio Rubber Co., 4 pp, ill, No. F-426. Detailed tabulation of the properties of natural rubber and rubberlike material. (182)

Plastic Glass Laminate. Plastilight Inc., 1 p, ill. Technical data on Epoglass (epoxy resin laminate) for use in electrical and electronic systems such as printed circuits. (183)

Nylon. Polymer Corp., 2 pp, ill, No. 13. Technical data on the use of Polypenco nylon in various applications. (184)

Plastic Parts. The Richardson Co., 4 pp, ill. Laminated and molded Insurok for fabricated parts, gear stock, etc. Uses of molded Insurok in many other applications. (185)

Molded Plastics. Shaw Insulator Co., 6 pp, ill. Facilities for engineering and production of plastic moldings. (186)

Rubber Parts. Stalwart Rubber Co., 16 pp, ill, No. 51SR-1. Describes applications and fabrication of rubber compounds designed to resist temperature, abrasion, chemicals and weathering. (187)

Carbon Brushes, Etc. Superior Carbon Products Inc., 24 pp, ill, No. 6-D. Specifications and applications of a complete line of Superior carbon brushes, carbon and metal graphite plates, silver graphite and silver alloy contacts and brushes, and carbon specialties. (188)

Plywood. Technical Plywoods. Brief particulars on Plytech, Fybrtech and Carstenite plywoods. (189)

Molded Thermoplastics. Tri-State Plastic Molding Co., Inc. Folder describes this company's facilities for producing to order thermoplastics parts by injection molding. (190)

Plastics Parts. U. S. Gasket Co., 48 pp, ill. Catalog describes properties and uses of Teflon, this company's various Teflon products and also gaskets of various materials. (191)

Carbon and Graphite Powder. U. S. Graphite Co., 66 pp, ill. Attractively presents detailed information on Graphitar, a carbon and graphite material for seals, bearings and plates, valves, piston liners, etc. (192)

Molded and Extruded Rubber Parts. Tyer Rubber Co., 8 pp, ill, No. 1P52. Detailed information on various types of molded and extruded parts of natural and synthetic rubber. (193)

Finishes • Cleaning and Finishing

Cleaning and Finishing Media. Almco Div., Queen Stove Works, Inc., 10 pp, ill. Features and applications of Supersheen Abrasive Chips and Compounds for barrel finishing and cleaning. Also data on finishing machines. (196)

Pickling Acid Inhibitor. American Chemical Paint Co., 2 pp, No. 13-1-1-4. Selection chart lists the principal types of Rodine and describes their most important characteristics. (197)

Aluminum Coating. Anodic Inc., 4 pp, with sample. Hard coating for aluminum—its properties and uses. (198)

Metal Cleaners. Apothecaries Hall Co., 4 pp, No. B-8. Complete data on a variety of Ahcoloid Metal Cleaners for soak tanks, electrolytic cleaning, power washers and tumbling barrels. (199)

Finishing Systems. Cincinnati Cleaning & Finishing Machinery Co., Sharonville, Ohio. 16 pp, ill, No. 200-QC. Discusses wide variety of complete finishing systems and equipment offered by this company. Write direct to Cincinnati on company letterhead.

Buffs and Polishing Wheels. F. L. & J. C. Codman Co., 24 pp, ill, No. 52. Presents a complete line of conventional and nonfray ventilated buffs and polishing wheels. Includes specifications. (200)

Degreasers, Washers, Processing Equipment. Detrex Corp., 4 pp, ill. Describes a variety of standard and custom-built degreasers, washers and processing equipment. (201)

Black Oxide Finish. Du-Lite Chemical Corp. Information on Du-Lite finishes for any steel blackening problem. Also gives information on Du-Lite cleaner, strippers, burnishing compounds, etc. (202)

Industrial Porcelain Enamels. Erie Enameling Co., 15 pp, ill. Lists advantages of porcelain enamels as an industrial finish and shows typical applications where they have been successfully used. (203)

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Disk-Type Buffs. Hanson-Van Winkle-Munning Co., 12 pp, ill, No. B-100. Complete data on Acme Ventilated Ruff-L-Buff pieced and full-disk buffs for cutting and coloring. (204)

Protective Coatings. Industrial Metal Protectives, Inc. Illustrated brochure describing Zincilate, which can be applied by spray, brush dip or flow coat methods to new products or existing structures. (205)

Phosphatizing. Kelite Products Inc., 2 pp, ill, No. 104. Lists advantages of using the Keykote process of phosphate coating iron and steel. (206)

Burring Metals. The Lea Mfg. Co., 6 pp. Standard practice for ferrous and nonferrous metals, also instructions as to which wheel and compound to use in burring. (207)

Silicone-Base Finish. Midland Industrial Finishes Co. Brochure describes silicone-base finish, said to resist heat of 500 F without discoloration. (208)

Barrel Finishing Equipment. Minnesota Mining & Mfg. Co., 12 pp, ill, No. A-1B. Describes barrel finishing, its uses and advantages, and suggests new applications for this company's abrasive chips. (209)

Belt Grinding. Minnesota Mining & Mfg. Co., 12 pp, ill. Describes the 3M method of belt grinding and finishing using coated abrasive belts as a means of high-speed grinding and finishing of flat or contoured surfaces. (210)

Aluminum-Chromium Paint. Monroe Co., Inc., 4 pp, ill, No. C-54-8. Includes detailed application data on Monco-Alochrom, an aluminum-chromium paint for exterior and interior surfaces of all kinds. (211)

Cleaning Metal Surfaces. Neilson Chemical Co. Data sheet describes this firm's products meeting government specifications for cleaning, rust removing, etching and protection of metals. (212)

Metal Cleaner. Niagara Alkali Co. Pamphlet gives properties of Nialk Trichlorethylene, high quality metal-cleaning and degreasing agent. (213)

Industrial Brushes. Pittsburgh Plate Glass Co., Brush Div., Dept. W-4, 3221 Frederick Ave., Baltimore, Md. Case histories indicate economies available to users of Pittsburgh brushes. Request on company letterhead direct from this company.

Plating Baths. Promat Div., Poor & Co., 4 pp, ill. Condensed information on a variety of zinc, cadmium, copper and white alloy plating baths that meet today's metal finishing requirements. (214)

Electrostatic Spray-Painting. Ransburg Electro-Coating Corp., 11 pp, ill. Describes new Ransburg No. 2 Electro-spray process, its uses and advantages. (215)

Surface Treatment. N. Ransohoff, Inc., 4 pp, ill. Equipment for washing, pickling, neutralizing metal parts prior to plating. (216)

Protective Coating. Ric-Wil Plastic Coating & Mfg. Corp., 4 pp, ill, No. S-5251. Includes physical properties and chemical resistance of Ricwilite 7100, a corrosion resistant, cold-set, phenolic resin coating. (217)

Mechanical Finishing. Roto-Finish Co. Folder describes uses and economies of Roto-Finish tumbling-type equipment for precision grinding, deburring and coloring metals. (219)

Electroplated Rhodium. Technic Inc., 1 p. Technical data sheet on electroplated rhodium also announces the availability of heavy rhodium plated deposits. (220)

Wet and Dry Tumbling. Tumb-L-Matic, Inc., No. PC-52. Describes five processes for finishing metal and plastic parts by tumbling parts with abrasive materials in rotating barrels. (221)

Protective Coating. United Chromium Inc., 2 pp, ill, No. RC-2. Properties and uses of Unichrome Coating 218X, a vinyl plastisol material for coating, plating and conveyor racks, plating barrels, agitators, etc. (222)

Hard Chromium Plating Unit. Ward Leonard Electric Co., 4 pp, ill. Features of Model A-20, Chromaster industrial hard chromium plating unit, description of process and Chromasol Solution. (223)

Heat Treating • Heating

Induction Furnaces. Ajax Electrothermic Corp., 8 pp, ill, No. 27A. Advantages and applications of, and equipment for induction heating and melting. Includes selector chart for induction heating and melting. (226)

Dissociated Ammonia. Armour & Co., 4 pp, ill. Reprint describes the economic advantages, uses and dissociating equipment used in the employment of dissociated ammonia. (227)

Radiant Glass Panels. Corning Glass Works, 8 pp, ill, No. B-86. Uses and features of Pyrex glass panels coated with electrically conducting coating for radiant heating and drying. (228)

Pressed Steel Pots. Eclipse Fuel Engineering Co., 6 pp, ill, No. N-1. Features specifications on a complete line of pressed steel pots for lead, salt cyanide, oil tempering and metal melting. (229)

Combustion Equipment. C. M. Kemp Mfg. Co., 27 pp, ill, No. B-11. Tells how combustion equipment offers fuel savings, is easier to install and to maintain, cheaper to operate. (230)

Steel Treating. Lakeside Steel Improvement Co., 12 pp, ill. Steel treating services described, including flame hardening, heat treating, nitriding, chapmanizing, etc. (231)

Surface Hardening Stainless Steels. Lindberg Steel Treating Co., 24 pp, ill. Complete data on the Malcomizing process for surface hardening stainless steels. Seven case histories are included. (232)

Tubular Furnaces. Marshall Products Co., 4 pp, ill. Discusses both the creep test and tensile test models of Marshall tubular furnaces, as well as control panels and radial brackets. Includes specifications. (224)

Salt Bath. Park Chemical Co., No. H-1. Specific applications, recommendations on the Neutra-Gas Process, an efficient and economical method of maintaining absolute neutrality in chloride-base salt baths. (233)

Annealing and Cleaning Brass Strip. W. S. Rockwell Co., 4 pp, ill. Describes continuous strip annealing process, an operation involving the preparation of brass strip for the annealing furnace. (225)

Conveyor Furnace. Sargeant & Wilbur, Inc. ill. Features specifications and advantages of this firm's conveyor furnace for bright brazing, hardening and annealing of stainless steel. (234)

Heat Treating. Stewart Industrial Furnace Div., Sunbeam Corp., 4 pp, ill. Monthly publication entitled *Metal Minutes* devoted to methods of heat treating and featuring a different installation each month. (235)

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Liquid Carburizing Salts. Swift Industrial Chemical Co., 4 pp, ill. Complete data on Swift polytherm blended liquid carburizing salts for imparting a hard, wear resistant surface to steel. (236)

Temperature-Sensitive Liquid. Tempil Corp., 1 p. A supplementary sheet of instructions for using Tempilaq, a temperature sensitive liquid for accurately determining attained temperatures. (237)

Low Temperature Equipment. Webber Appliance Co., 8 pp, ill. Description of low temperature industrial freezers and complete temperature range testing units. (238)

High Temperature Metal Conveyor Belts. Wickwire Spencer Steel Div., 24 pp, ill. Construction features and applications of various types of metal and wire conveyor belts for high temperature use. (239)

Welding • Joining

Welded Parts. Acme Tank & Welding Div., 4 pp, ill. Shows this plant's facilities for welding complex shapes and discusses advantages of using welded construction by competent welders. (242)

Joining and Sealing Aluminum. All-State Welding Alloys Co., Inc., 6 pp, ill. Gives information on how to use and apply All-State alloys and fluxes for soldering, brazing and welding aluminum and aluminum alloys. (243)

Low Hydrogen Electrodes. Arcos Corp., 8 pp. Question and answer description of low-hydrogen electrodes for welding high tensile steels. Lists electrodes, coating types and uses. (244)

Bonding Resins. Ciba Co., 4 pp, ill. Properties of new group of resins, their applications as adhesives for metals and nonmetallics, moldings and coatings. (245)

Electric Ovens and Furnaces. Cooley Electric Mfg. Corp., ill. Describes a complete line of electric ovens and furnaces produced by this company. Includes specifications. (246)

Welding Positioners. Cullen-Friestadt Co., ill. Catalog shows line of hand- or power-operated welding positioners with capacities up to 30,000 lb. (247)

Gas Heating Units. Gas Appliance Service Inc., 4 pp, ill, No. 511. Shows various types of conveyor and turntable-type heating units for volume brazing, soldering, annealing and hardening. (248)

Steel Fabrication. Gussett Boiler & Welding, Inc., 8 pp, ill. Describes facilities for steel and alloy plate fabrication of vessels, tanks, hoppers, stacks, machine bases and other weldments. (249)

High Temperature Fastenings. Aero Div., H. M. Harper Co., 16 pp, ill. Complete list of screws, bolts nuts and washers of high temperature corrosion resistant alloys and titanium. Includes tables of chemical and mechanical properties. (250)

Welding Speed Steels. W. J. Holliday & Co., 4 pp, ill, No. 907. Detailed information on welding Speed Case (X1515), Speed Treat (X1545) and Speed Alloy Plate. (251)

Fastener. Huck Mfg. Co., 5 pp, ill. Description and specifications of Huck Lockbolts, new high shear strength fasteners incorporating principles of rivets and bolts. (252)

Effective Use of Locknuts. Industrial Fasteners Institute, 23 pp, ill. Descriptions and principles of operation of representative types of locknuts. (253)

Aluminum Fasteners. The Jacques Co., 8 pp, ill, No. 50A. Price list and specifications of this company's line of aluminum fasteners. (254)

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Silver Brazing Preforms. Lucas-Milhaupt Engineering Co., 10 pp, ill. Features an interesting article on the advantages of using silver alloy preforms. Includes detailed specifications. (255)

Electrodes. McKay Co., 4 pp, No. 8. Technical Bulletin No. 8 describes operation and usability of Frogalloy M and C electrodes, and contains chart detailing hardness vs impact of these electrodes. (256)

Electrodes and Holders. P. R. Mallory & Co., Inc., Welding Div., 2 pp, ill, No. 8-11. Advantages, design and application of 8-deg (4 deg per side) 5/8-dia spot welding electrodes and holders. (257)

Precious Metal Solders. The J. M. Ney Co., 1 p. Melting ranges, colors and identification numbers of this company's gold and platinum solders for electronic tubes. (259)

Induction Brazing. The Ohio Crankshaft Co. "Typical Results of Tocco Induction Brazing and Soldering" shows by case histories the advantages of these fastening methods. (260)

Self-Clinching Fasteners. Penn Engineering and Mfg. Corp., 16 pp, ill. Gives dimensional data on this firm's self-clinching and self-locating fasteners. (261)

Steel Bolts. Pittsburgh Screw and Bolt Corp., 12 pp, ill, No. 101. Complete data on high tensile steel bolts for structural points, including a research report and case histories. (262)

Fastener Demonstrator. Set Screw & Mfg. Co. Cardboard demonstrator shows the way Zip-Grip set screws lock themselves into place. (263)

Self-Locking Nuts. Shakeproof Inc., 6 pp, ill, No. 1. Illustrates seven applications of Keps pre-assembled nuts and lockwashers to otherwise difficult bolted assemblies. (264)

Special Fasteners. The Townsend Co., 4 pp, ill, No. TL-63. Descriptions and advantages of Nylok Locknuts and Tufflock Nuts, including specifications and available finishes. (265)

Welding Positioners. Worthington Corp., Industrial Div., 36 pp, ill, No. 210C. Description, features and applications of 100 to 40,000-lb capacity welding positioners. (266)

Forming • Casting • Molding • Machining

Die Casting Machine. A. B. C. Die Casting Machine Co., 4 pp, ill. Complete details and specifications of the 1-lb zinc ABC die casting machine. (267)

Coated Abrasives. Armour Sandpaper Works, 124 pp, ill. Catalog of complete line of coated abrasives. Includes tables. (268)

Wet-Abrasive Cut-Off Machine. The Cincinnati Electrical Tool Co., 2 pp. Description, features, alternating and direct current specifications of this wet-abrasive cut-off machine. (269)

Moly-Sulfide Lubricant. Climax Molybdenum Co., 40 pp. Detailed tables of applications of moly-sulfide lubricant in the manufacturing plant, the job shop and in the field, indicating form used, and results of application. (270)

Presses. Denison Engineering Co., 16 pp, ill. Features the installation and uses of the Denison hydraulic Multipress. (271)

Die Casting Machines. Lester-Phoenix, Inc. Folder gives description, features and specifications of this company's die casting machines and injection molding machines. (272)

Casting Riser Compound. Metal & Thermit Corp., 10 pp, ill. Catalog describes Thermit Riser Compound, designed to assure sound castings, and gives instructions on its use. (273)

D. C. Welder. Miller Electrical Mfg. Co., 8 pp, ill. Specifications and accessories for d.c. arc welding units. (274)

Machine Tool. Newage International Inc., 7 pp, ill. Description of the Rinds machine tool for a variety of work in experimental fabrication and design. (275)

Contour Shear. Wales-Strippit Corp., 4 pp, ill, No. TS. Discusses the Wales True-Edge contour shear for circle and shape cutting, heading and forming. Includes specifications. (276)

Adjustable Perforating Dies. S. B. Whistler & Sons Inc. Catalog describes this company's line of adjustable perforating dies for punching holes in sheet metals. Includes prices and applications. (277)

Inspection • Testing • Control

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Hardness Testers. Steel City Testing Machines, Inc., 8 pp, ill, No. P-953. Catalog of Brinell hardness testing machines, including illustrations and complete specifications on more than 1/2 dozen types, plus miscellaneous accessories. (288)

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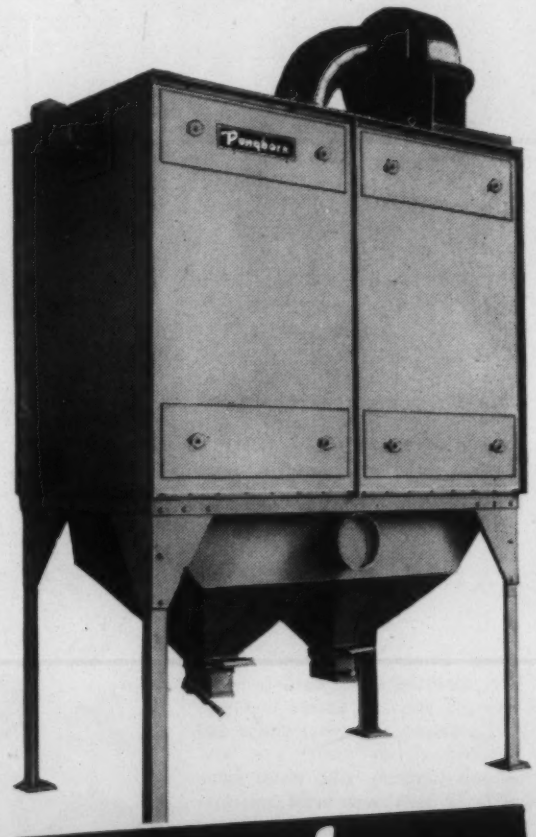

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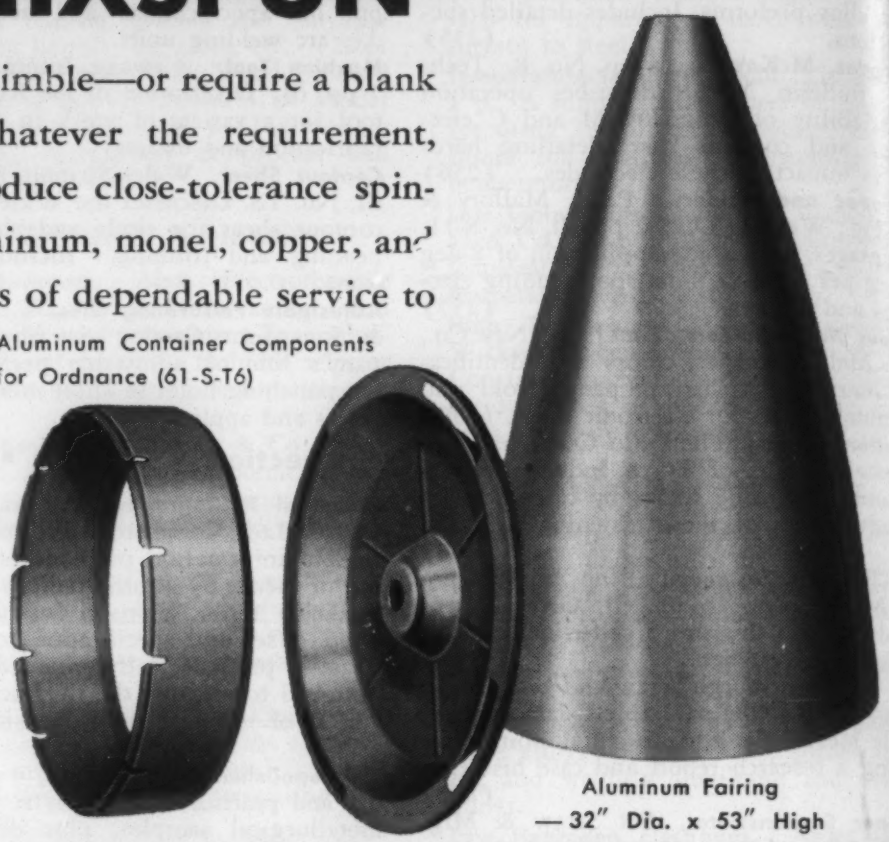

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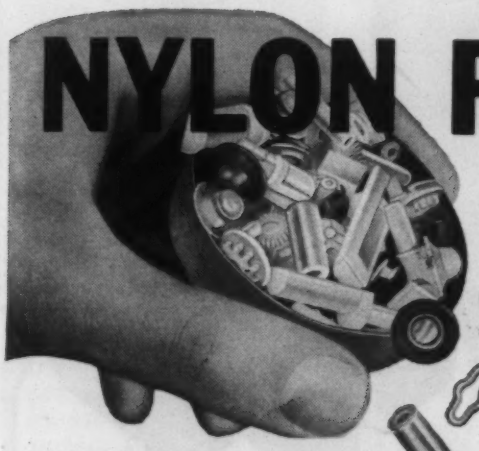

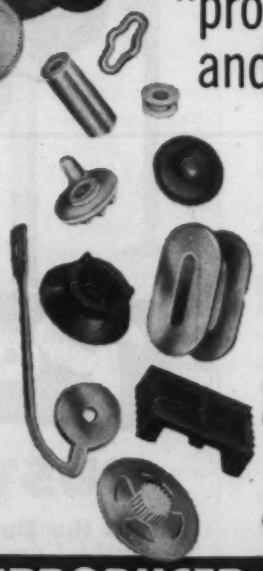

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